The Manufacture of Nickel Jacketed Bullets.

BY E. A. SUVERKROP.

At a time when war is raging in the Far East and thousands of men are being killed, it is not to be wondered at that people in passing thru the St. Louis Exhibition should have been attracted to the Government Building, where a bewildering array of engines and accoutrements of war are to be seen. One of the, to me, most interesting exhibits was that from the Frankford Arsenal, where a series of machines were making rifle cartridges. As cartridge-loading machinery is fairly well

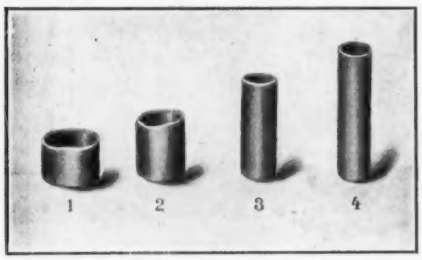


FIG. 1. FIRST FOUR DRAWINGS OF JACKET.

known, I will confine myself to the manufacture of the nickel jacketed bullet.

With the advent of small bores and high muzzle velocities, it became necessary to harden the bullets. Lead, while cheap and heavy (two attributes which a bullet that is to be used in enormous quantities must have), was not hard enough. The admixture of tin, antimony, etc., while hardening it to a certain extent, did not make the lead hard enough to resist the tendency to "strip" or slide straight thru the rifled barrel. This "stripping" has two disadvantages. Not only is the steadying effect of the rotative motion (imparted to the bullet by the rifling) lost, but the barrel becomes "leaded"—*i. e.*, the lead is scraped from the surface of the bullet by the rifling grooves. These particles of lead adhere to the steel and render further use of the rifle dangerous until they have been removed. The cleaning of a "leaded" rifle is quite a tedious affair. To avoid these troubles the expedient was hit upon to make the bullet of lead (because of its weight and cheapness) and cover the outside with a jacket of nickel alloy.

While there are many machines for stamping bullets from lead rods, which machines are used almost exclusively by private enterprises, the bullets which were used at the exhibit were not made in this way, but were cast. A large number were cast at one time, the flat end of the bullet being cut off by a trimming shear before the bullet is removed from the mold. At the bottom or pointed end of the mold a small hole is drilled thru the casting. Into these holes wires are put which are attached to a plate below the mold. After the mold has been poured and the flat ends sheared, the plate with its attached wires acts as an ejector in case any of the bullets should stick. This of course seldom happens, as the molds are made slightly taper, and the lead in cooling shrinks slightly. These bullets were not made at the exhibit but came, I believe, from the Frankford Arsenal.

The nickel jackets are made in regular automatic drawing presses. Fig. 1 shows the first four drawing operations. The sheet of nickel alloy is fed into the double-acting press and the cup 1 is the result. I did not time the machines, but they were running from 60 to 80 strokes a minute.

The four operations on the jacket are similar, the cups, after the first drawing, being put into a hopper and fed therefrom automatically thru a tube to the die for the second operation and so on. The edges of the cups are left irregular from the drawing operation so (before being put into the machine which envelopes the lead bullet with the nickel jacket) the cups are trimmed to length.

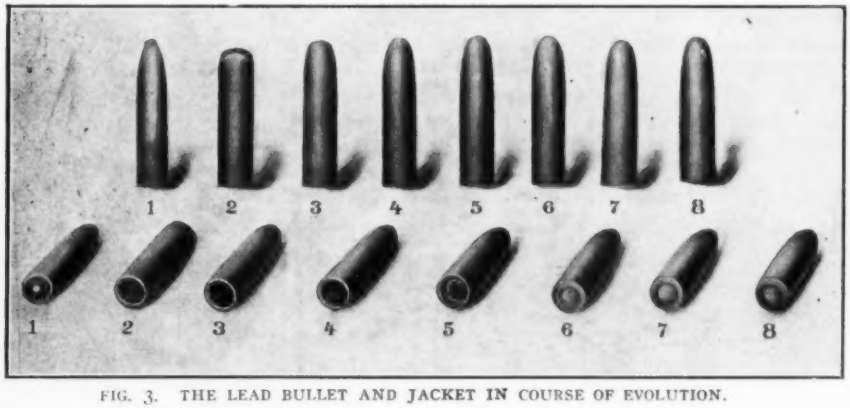


FIG. 3. THE LEAD BULLET AND JACKET IN COURSE OF EVOLUTION.

The next series of operations, six in number, are performed on one machine, every stroke of the machine performing six different operations upon six different bullets in six different stages of completion and consequently producing one complete bullet each stroke.

Fig. 2 is a perspective view of the disks of the jacketing machine. I have left out the ram, as it and its guides and punches would obscure the view of the die where the actual work is done. The two disks *M* and *L* are of equal diameter. They are geared together and indexed so that at each stroke of the press one hole in the upper plate will register with one die in the under plate.

The operation of the machine is this: A girl sits at *N* and inserts lead bullets as shown at No. 1, Fig. 3, point downward in the holes in disk *M*. Another girl sits at *O* and inserts the jackets, see No. 2, Fig. 3, in the dies in disk *N*. There are six punches, as before stated, in the upper ram. When the first jacket reaches the position occupied by the die marked *A*, Fig. 2, the first punch enters it and *partly* points it, see No. 3, Fig. 3. The metal would not stand being drawn up to its finished shape at the point at one stroke. The next indexing brings the jacket to position *B*,

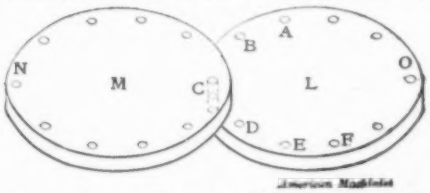


FIG. 2. DIE PLATES OF JACKETING MACHINE.

where the point is finished, see No. 4, Fig. 3. The next indexing brings the jacket underneath the lead bullet carried in the upper disk at position *C*, when the punch pushes the bullet into the jacket see No. 5, Fig. 3. The next indexing brings the jacket with the lead bullet inside it to the position indicated by *D*, this punch in descending crimps the end of the jacket (which is a little longer than the lead bullet) over toward the inside all round see No. 6, Fig. 3. At the next indexing a flat-faced punch descends and flattens the end, see No. 7, Fig. 3. The final or sixth

FIG. 4. THE FINISHED BULLET.

punch pushes the jacketed bullet thru a sizing die and thence into a receptacle on the floor, see No. 8, Fig. 3.

The limit of accuracy is .001, and I was informed that the life of a sizing die is about a day. Owing to their shape, they are not expensive dies to make.

The final operations on the bullet (before it is assembled in its shell with a full charge of highly safe flaxseed behind it) is to taper its rear end slightly so that it will enter the shell easily, and to mark the end with a little "o" so that the fin-

ished and tapered bullet may be distinguished from the bullet which has not received these finishing touches. Without this distinguishing mark "o" they are both apparently the same. Fig. 4 shows the bullet with the "o" mark.

The finished cartridges were distributed as souvenirs to the visitors.

German Automatic Cutter Grinders.

In Fig. 1 is illustrated a machine designed for automatically sharpening milling cutters and reamers of various types and adapted also, by the application of a special work-driving fixture, to cylindrical grinding operations. The machine will receive work up to 6 inches diameter and 8 inches long; its construction and operation will be clear from the general view in the half-tone, and from the line engraving, Fig. 2 altho the latter, it should be noted, shows a machine of a slightly different model, but coinciding in most essentials with the grinder in Fig. 1. The chief point of difference lies in the drive for the wheel spindle, which drive, as now arranged and shown in the half-tone, is derived from a belt passing over a pulley located at the center of the spindle with a bearing at either side. The wheel spindle, which runs in hardened and ground conical bearings, is carried in a vertically adjustable head, which is also arranged to swivel at the front end of a ram, the latter having a reciprocating motion thru the medium of a rocker arm actuated by eccentric and elliptical gearing, crank disk and connecting rod, all of which are clearly represented in the line drawing. The stroke of the ram may be varied from 0 to 10 inches by shifting the position of the crank pin in the disk. The

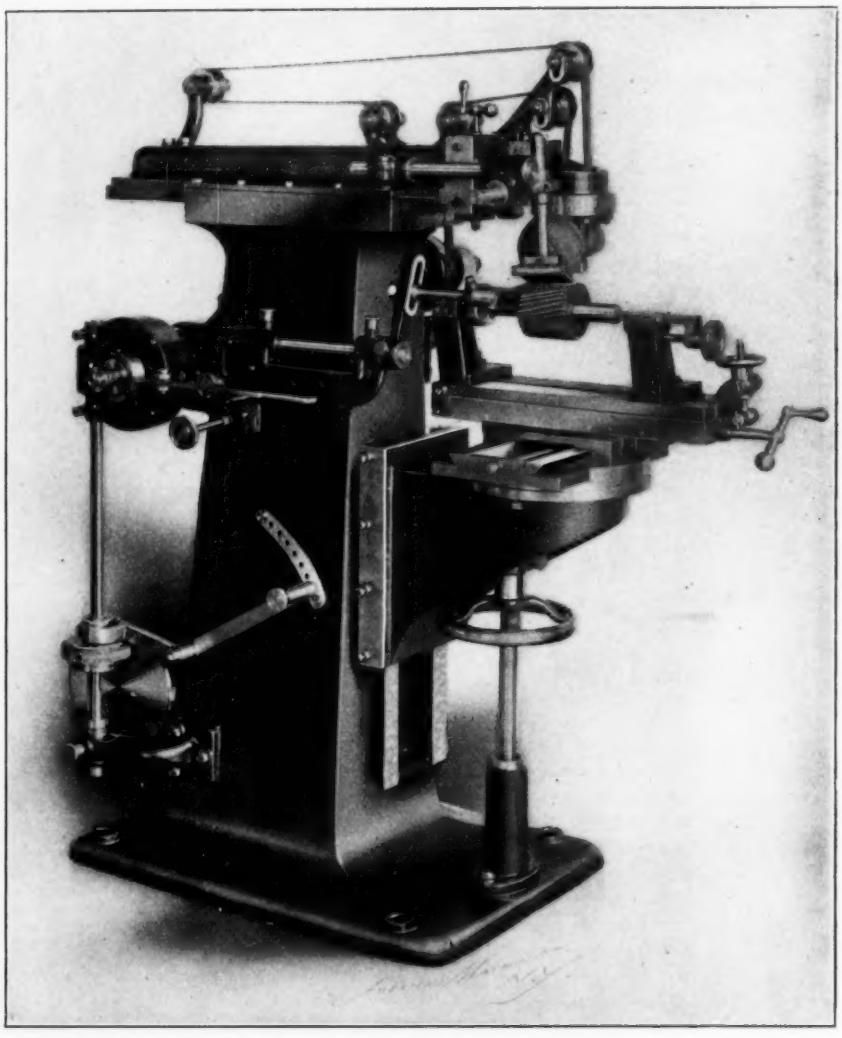


FIG. 1. AUTOMATIC CUTTER GRINDER.

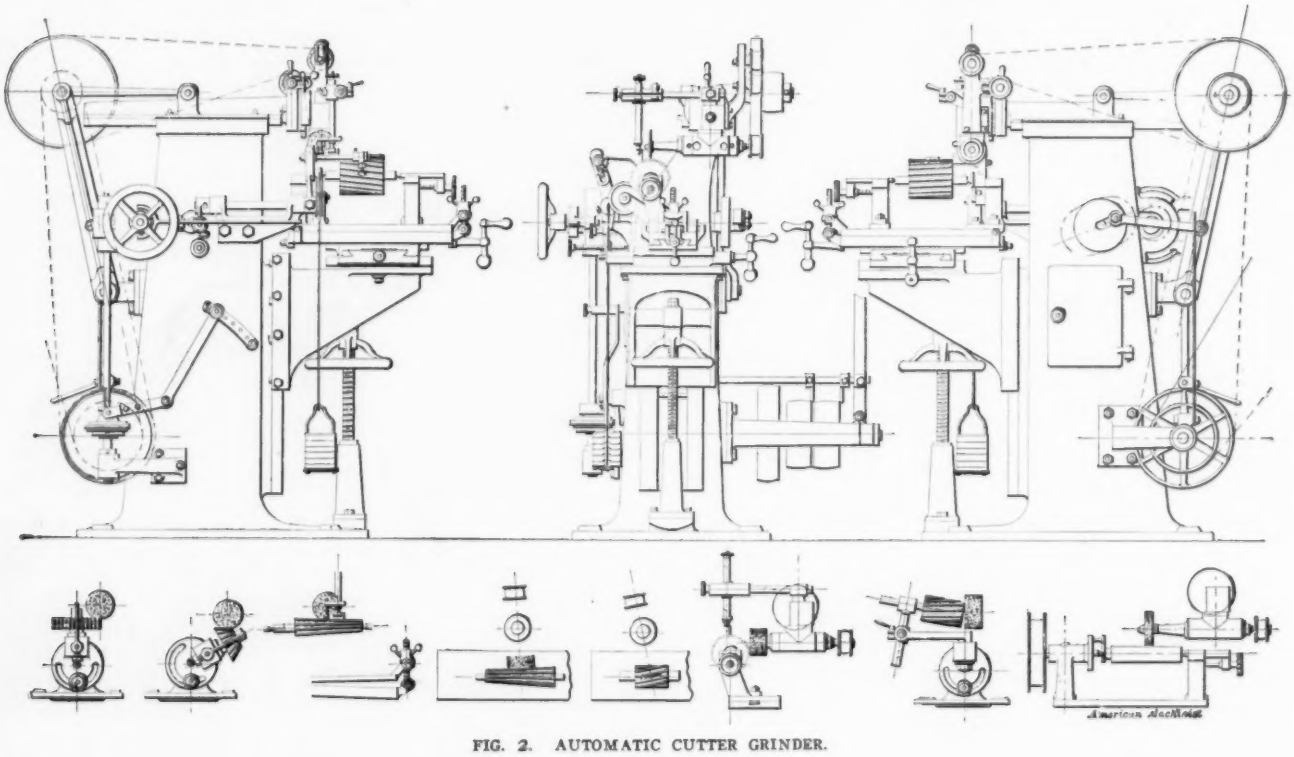


FIG. 2. AUTOMATIC CUTTER GRINDER.

drive is taken by pulleys on the shaft at the base of the grinder and transmitted thru friction disks and worm gearing to the crank disk above. The lever for changing the position of the driven friction disk, and hence the speed of the ram, will be noticed at the left-hand side of the machine. At this side will be seen also the mechanism for indexing the cutter as it is ground tooth by tooth. The pawl carried by the rocker device engages with the cutter tooth and throws the cutter ahead upon the completion of the return pass of the ram and wheel. The cutter is held back against its tooth rest or guide by a weighted cord attached to the arbor driver in the manner shown in Fig. 2. The work table may be adjusted sidewise, endwise and vertically, and may be swiveled to suit spiral teeth of any angle.

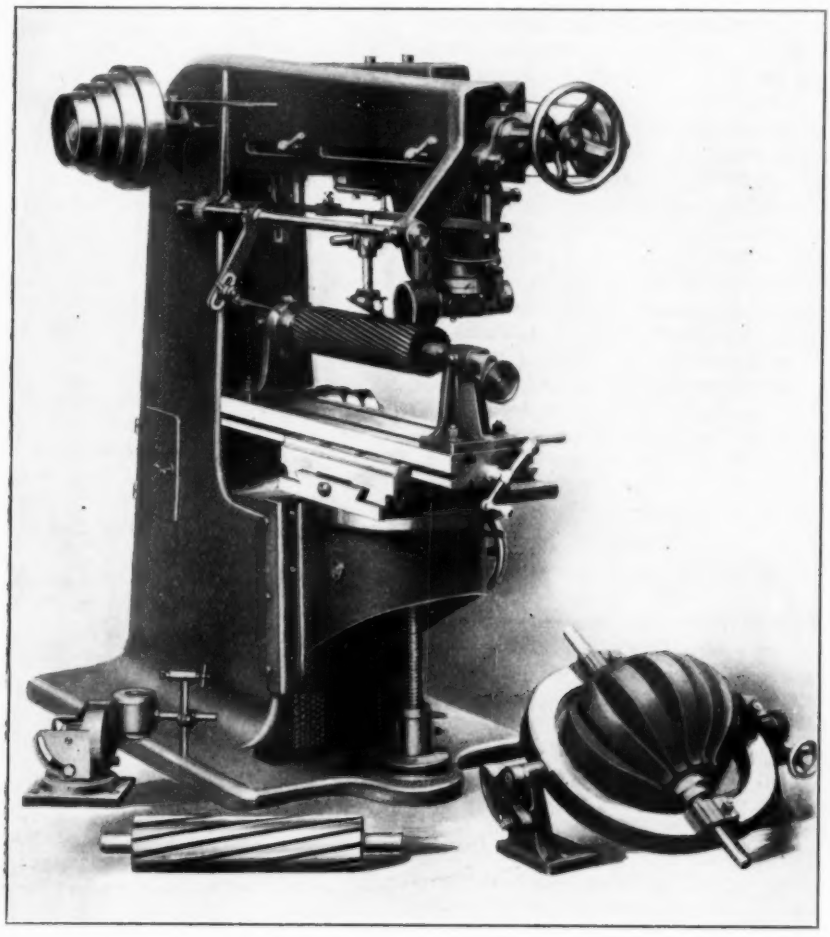


FIG. 3. HEAVY AUTOMATIC CUTTER GRINDER.

The machine in Figs. 3 and 4 has a capacity for cutters up to 12 inches diameter and 24 inches long. The head in this design is reciprocated on an overhanging support by a screw which is driven alternately in opposite directions thru reversing gear in the arm. The rod with its tappets for controlling the reverse will be noticed under the rail. The wheel spindle is arranged and driven in practically the same manner as the spindle of the machine already described. The drive for the screw is by means of the four-step cone pulley at the top of the machine: the three-step cone at the opposite side drives the shaft and pulley for actuating the wheel spindle.

Face mills, angular and other cutters may be ground on these machines by mounting on attachments supplied for the purpose. The small machine weighs 1,430 pounds; the heavy one, 4,850 pounds. Friedrich Schmaltz, Offenbach-on-Main, Germany, is the builder.

A metal casting process recently patented by John H. Forbes, Cincinnati, provides for making certain portions of a casting, such as the tread of a car-wheel or the hub of a loose pulley, of different material from the body of the casting, this result being secured by placing in the mold a quantity of chips or turnings of the required composition and retaining them in the desired position during the pouring by the action of electro-magnets suitably placed outside the mold or in the hub core, as the case may be. Nothing in the patent specification indicates what success, if any, has attended the application of the process.

The new Springfield rifle at a distance of 50 feet penetrates fifty-five 1-inch boards set 1 inch apart. It gives a muzzle velocity of 2,300 feet per second and will carry a ball five miles.

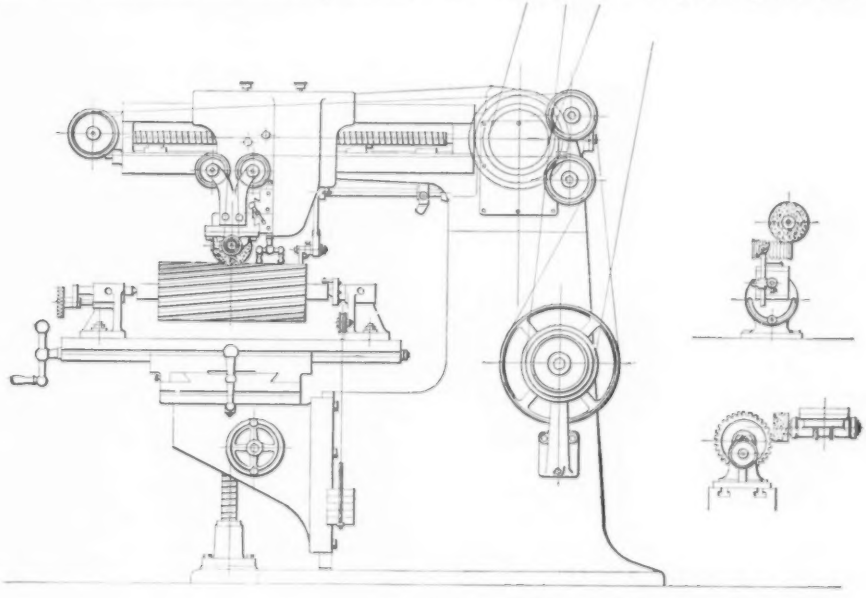
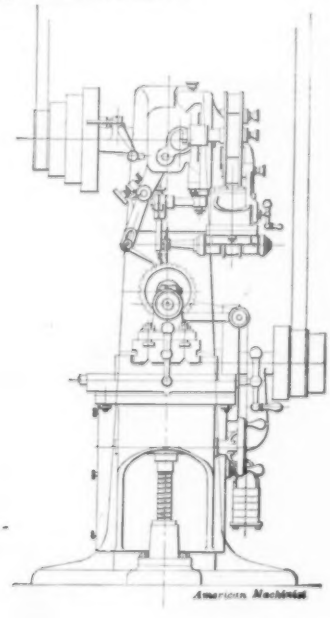


FIG. 4. HEAVY AUTOMATIC CUTTER GRINDER.



Studies in Inventive Problems—II.

Proposed by Leicester Allen and Solved by Various Readers.

Many people who write for publication wait and wonder why their communications do not appear. They do not take into consideration (because they do not know) the fact that the next issue is already on the press, the next after that is in type, and the succeeding one is all planned out with the cuts for it in the hands of the engraver. Several weeks after sending in a contribution a writer may be surprised by the appearance of what he had feared had been consigned to the waste-basket. Few of us old stagers have not in our earlier years felt the keen pleasure of such a surprise. "It was not so deficient after all," said we to ourselves; and if, after this first flash of encouragement, our eye chanced to light on some editorial note of approval, our pride rose proportionately. Perhaps, instead of approval, it was a kindly criticism, and then we did not feel quite so well; but we found comfort in the reflection that, at any rate, it was worth this *editorial* attention, and said (again to ourselves) "Next time." Hope built on pride of achievement kept up our courage for the "next time," and here we are. Look thru the columns of the letters printed during a year in the AMERICAN MACHINIST and see for yourself. No technical school on this continent contributes more to sound progress than this department.

Thus much to those who, contributing solutions to the problems presented here-

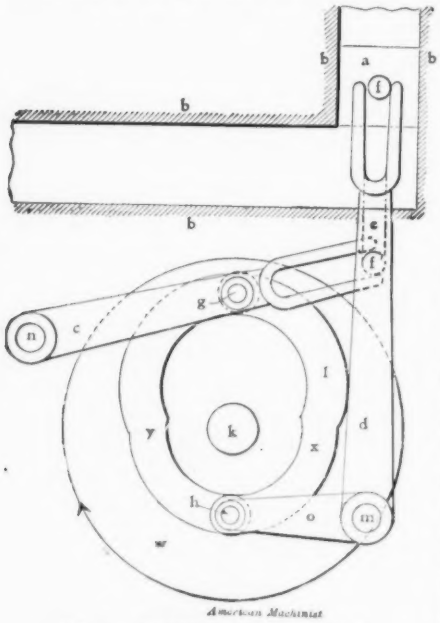


FIG. 1. SOLUTION OF PROBLEM I.

in, have to wait a time before they know the outcome. To be ready for this January shop number, I can present only three solutions; others which have come in later than these must bide their time. They will not fail to receive attention in their proper order.

It should be understood that solutions which accomplish with certainty the required results with fewest parts, provided such parts are not difficult to construct, or liable from certain peculiarities to soon get out of repair, or to cause inconvenience by their inaccessibility, are really the best solutions. In construction no one should use two parts where one, equally simple in construction, no more liable to get out of repair and as easily accessible for examination, lubrication, adjustment and repair, will accomplish the same results.

In the first article of this series it was said that free criticism within courteous limits would be allowed. I might have said such criticism is invited. It is the privilege of anyone, whether sending solutions or not, to criticise solutions, my own as well as the rest; for it should be fully understood that no problem will be herein presented that I have not solved prior to its publication.

PROBLEM I.

SOLUTION NO. 1. FROM H. GEARING, TORONTO, CANADA.

This problem was presented at page 1621 and Mr. Gearing's solution was mailed on the third day after its publication; so it took only a very short time for him to see his way to do it. The letter head of the writer in this case indicates that he is by profession an inventor and designer, and this exemplifies the fact that practise in working out such problems increases the readiness with which such subjects can be met successfully. To afford scope for such practise is precisely the object of this series of problems.

Mr. Gearing reaches a complete solution by a combination of rock-levers and a cam. His description is substantially as follows:

"The block, to be moved horizontally thru a certain distance and then vertically thru half the horizontal distance, is shown at *a* and the guides at *b*. The rock-lever *c* effects the vertical movement by its action upon the bar *e* attached to, and moving with, the block *a*. Levers *o* and *d* keyed to the rock-shaft *m* together form a bell-crank the longer arm of which effects the horizontal movement. Both the levers *c* and *d* are forked at their free ends, lever *c* operating pin *f'* at the lower end of the bar *e*, and lever *d* operating pin *f* in the sliding block *a*. For the pins *f* and *f'* would be substituted in actual construction either rollers or sliding blocks. The levers *c*, *d* and *o* are moved by rollers *g* and *h* respectively working on stud-pins fixed in the lever arms in the proper positions relatively to the rock-shafts *m* and *n* to secure the right proportion between the horizontal and vertical movements. These rollers run in the groove *l* of a cam wheel *w*, which rotates continuously in the direction indicated by the arrow. The block *a* is shown at the upper end of the vertical branch of its path, having been moved to that position by a quarter-turn of the cam wheel from *g* to *x*. The next quarter-turn of the cam wheel, from *y* to *g*, pulls down the block *a* so that the pin *f* reaches and lies in the lower part of the fork in the rock-

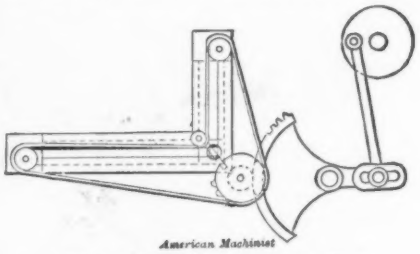


FIG. 2. SOLUTION OF PROBLEM I.

lever *d*. During both the upward and downward movement so far described the lever *o* and the lever *d* have been maintained in a fixed vertical position, because that part of the cam groove lying between the points *x* and *y* is concentric with the cam shaft *k*. But the quarter-turn of the cam wheel which brings the slide pin down into the lower part of the fork in the lever *d* brings the part *x* of the cam groove into engagement with the roller *h*, and the part of the cam groove marked *y* into engagement with the roller *g*. For the next half-turn of the wheel the concentric part of the groove holds the roller *g* in a fixed position, and the oscillation of the lever *d*, while the eccentric part of the groove controls the roller *h*, moves the slide to and fro over the horizontal branch of the path. These alternate movements of the levers *c* and *d* effect the desired movement of the slide thru its prescribed path."

This combination of parts would require to be laid out very carefully to insure sufficient exactness of motion in the sliding block. As the lever *c* remains fixed in a horizontal position during the oscillation of the lever *d*, the forkways of *c* ought to be curved on a radius from the center of the shaft *m*. If left straight they must be placed far enough apart to allow for the curvilinear motion of the pin or roller *f'*, in which case there would be a pause at the angle of the path, which is contrary to the requirements. But properly laid out, I think it could, with good workmanship, be made to operate fairly well.

SOLUTION NO. 2. FROM W. DEATS, YONKERS, N. Y.

This solution, the second received, is numbered accordingly. The solutions will be numbered in the order of their arrival for each problem in the series. Mr. Deats' sketch is very neatly executed. He sends also a description which is available without use of reference letters. He uses a combination of a sprocket wheel and a chain for actuating the sliding block, the chain being run over idlers.

"In an endless chain one link is pro-

vided with a pin projecting inwardly. This pin has a running fit in a hole in a stud which has also a running fit in a hole in the sliding block. The chain runs over three idlers and a sprocket, as shown. One of the idlers should be made adjustable to take up slack in the chain. The movement of the sprocket is reversed at each extremity of the travel of the block, the sprocket being driven by a toothed quadrant oscillating on a central bearing, a slotted arm projecting opposite the toothed part, as shown. The slotted arm is made to oscillate by a connecting rod attached to a crank-pin in a wheel which turns constantly in one direction, the direction of turning being immaterial. By adjusting the pin in the slot of the arm of the segmental rack the slide can be given more or less travel. A turnbuckle in the connecting rod could be used to give the proper limit to the travel. A cam, instead of the crank motion, made to slow down the slide at the angle, would give the best results. The sliding block is shown in the angle for the sake of clearness; in reality it ought to be shown at the half-travel position, since the rest of the mechanism is so shown."

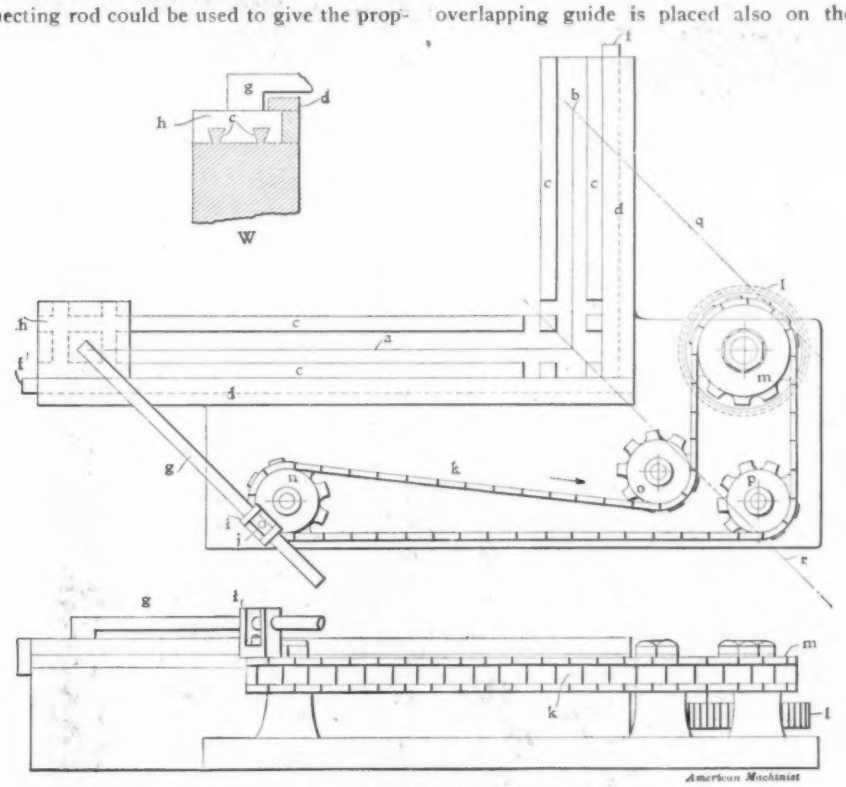


FIG. 3. SOLUTION OF PROBLEM I.

SOLUTION NO. 3. FROM E. PIERCE, ILION, N. Y.

This solution also is a sprocket wheel and chain combination, but differs from that of Mr. Deats by making the sprocket chain run continuously in the same direction, thus avoiding some of the mechanism used by Mr. Deats. Notwithstanding its greater simplicity, I do not think it would do very well in any case where the block if used to carry, say, a cutting or a bending device which would meet any material resistance to its movement. But as possible resistance of any magnitude was not embraced in the statement of the problem, Mr. Pierce must be credited with a solution of the problem as presented, since his combination will move the block when running light, in the path prescribed and to and fro in that path. But Mr. Deats' combination would probably not work well if the block were subjected to much resistance. I subjoin Mr. Pierce's explanation:

"A horizontal line of travel of convenient length is represented in the sketch at *a*, and a vertical extension of the line at *b* one-half the length of *a* also is shown, these two branches forming the prescribed path for the geometrical center of the sliding block. The ways are shown in section at *W*. These ways are dovetail in form and parallel to the path. Thru the angle they are milled thru in both directions. An overlapping guide is placed also on the front side at *d*. A stop *f* at each end of the travel is convenient in adjusting the arm *g* and sliding block *h*, but, not being essential to the operation of the combination, may be omitted. The block *h* is properly grooved in both directions to take the ways without turning at the angle of the path. The arm *g* is rigidly fastened to the block, and slides thru two lugs of a piece *i* which rotates on a stud *j* fastened to the outside of one of the links of the sprocket chain *k*. This chain is driven by a sprocket *m* which is fast to, and turns with, the gear *l*, always rotating in one direction. The chain is supported, also, by the sprockets *n*, *o* and *p*. The oblique lines *q* and *r* show the relative positions of the parts at different points of travel. It will be seen that the idler *o* must be located to the left of the line *r* to allow the chain and piece *i*, which are traveling in the direction indicated by the arrow, to carry the square block exactly to the corner and thence upward, no stop being made; but the speed will be somewhat lessened as the stop approaches the corner thru the distance equal to one-half the pitch circle of the idler. The idler *p* is, for the same reason, offset on the opposite side of the line *r* for the return stroke.

"While much may be said pro and con as to the practicability of this mechanism for various uses, I think that, in a general way, it is a fair solution."

The substance of the foregoing paragraph has already been conceded to Mr Pierce, who has presented his case in capital form both by his excellent drawing and clear description. But I think mechanics would regard the long arm *g* rigidly attached to the sliding block as calculated to make the block run hard in the ways, even if it had no resistance to encounter other than its own inertia and friction, because the tendency to turn against the ways of diagonally opposite corners of the block caused by the leverage of the arm with the driving force applied at the extremity of the arm as proposed must be very pronounced.

I will not present my own solution until it becomes probable that all the solutions likely to be offered have come to hand. I will then state another problem which, I think, will prove somewhat more difficult.

To Get More Heat From a Radiator.

There are a good many rooms where the radiator is either too small or the steam pressure too low to maintain a comfortable temperature in severe weather. If the tenant is enjoying the many advantages afforded by central station electric lighting service, the matter can easily be remedied. Take the fan that kept you cool all summer and set it where it can blow against a large part of the radiator's surface. Turn it on at low speed, or at high if necessary, and your cold room will soon be thoroughly warmed. The philosophy of the thing is that steam at a low pressure carries much less latent heat than steam at a high pressure, and therefore warms the radiator so poorly that only a slight draft of air rises around the pipes, and condensation is slow. With the fan in operation there is a forced draft against the radiator that conducts a great deal more heat away from the iron, cooling it so that much more condensation of steam occurs inside it. The heat thus snatched from the reluctant radiator is held in the circulating atmosphere of the room, which is soon changed from cold to warm at a trifling cost for electric energy.—*Electric City.*

The American Locomotive Company has presented to Purdue University, Lafayette, Ind., the full-sized model locomotive cylinders sectioned to show the piston valve construction, which formed a part of its exhibit at the Louisiana Purchase Exposition.

Portable Electrically-Driven Tools at the Works of the Allgemeine Elektricitaets Gesellschaft, Berlin, Germany.

We have received from M. Emile Guarini, of Brussels, Belgium, a series of photographs showing these great works, from which we make the accompanying selections, showing interesting applications of motor driving to portable machine tools.

Fig. 1 shows an application of a small motor to the driving of a breast drill thru the medium of a flexible shaft, and Fig. 2 shows a similar motor and shaft as used in yard work on heavier drilling with a portable drill support, while Fig. 3 shows a more powerful motor applied to floor work in which the holes are much larger. Fig. 4 shows an interesting central drive by which power is delivered from one motor to two drills, and we judge the central drive to be fitted for connection to additional drills. Fig. 5 shows a similar motor to that illustrated in Fig. 3, but suspended from a crane and connected to the drill by a universal jointed telescopic shaft in place of the flexible shaft, and Fig. 6 shows still another application of the telescopic shaft. We are not informed regarding the relative merits of these two methods of connecting the motor and drill. It might be inferred that the telescopic shaft is better suited to heavier work, but it will be seen, on the contrary, that the drill shown in Fig. 3 is larger than those shown in Figs. 5 and 6. On the other hand, the ratio of reduction of speed is obviously greater in Fig. 3 than in Figs. 5 or 6. Fig. 7 shows a radius arm connection to a small drill press, the radial arm being partly of wood and the base of the drill press being fitted with a slide for accurate adjustment.

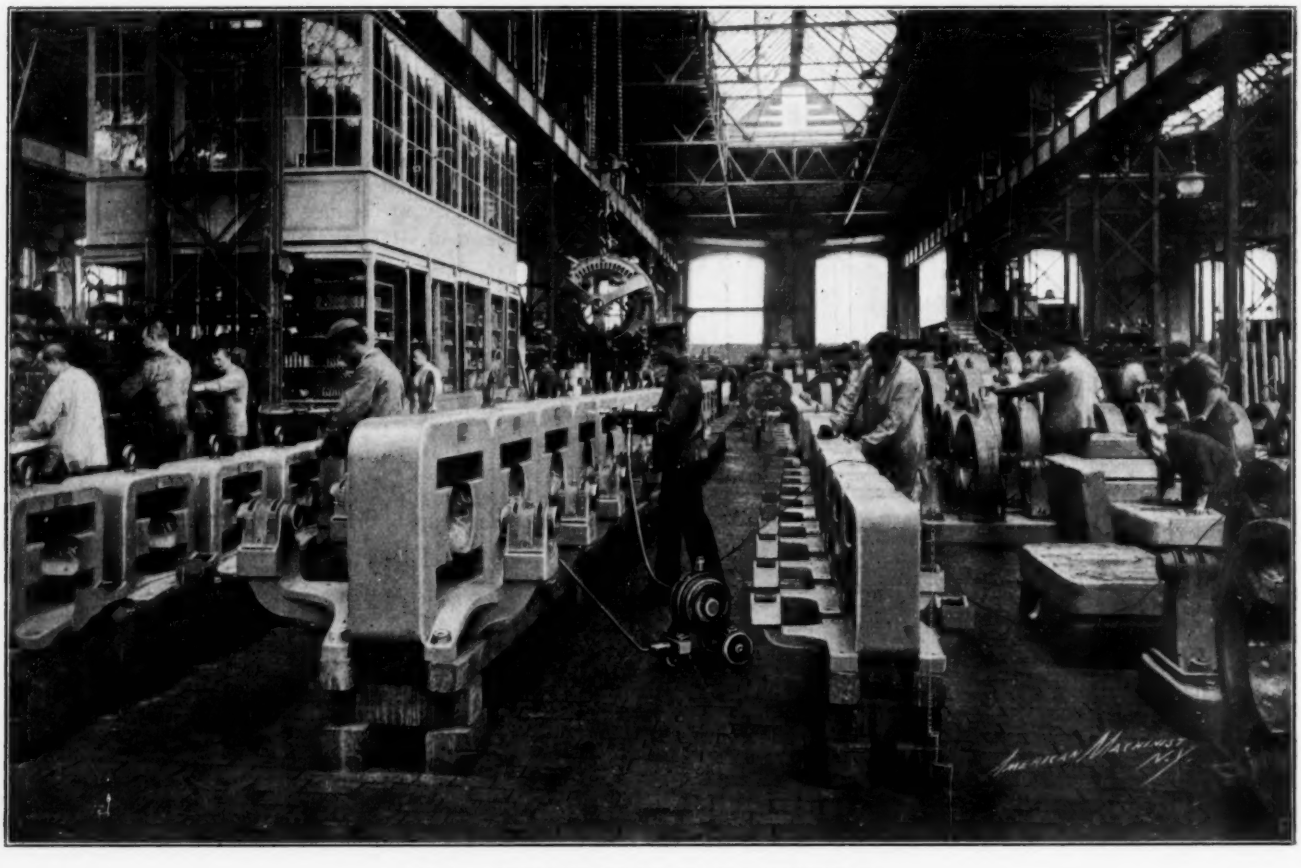


FIG. 1. A SMALL MOTOR APPLIED TO A BREAST DRILL.

American Traveling Salesmen in New South Wales.

F. W. Goding, United States Consul at Newcastle, New South Wales, speaks as follows in *Consular Reports* of the improvement in the character of the traveling salesmen sent out by American firms and of the increased success due to their efforts:

"During my residence here of six and a half years the character of the traveling salesmen representing American houses has changed decidedly for the better. As a result, many lines of American goods and wares have lately been introduced which formerly were not known here. As an instance, the selection of coal-cutting machines of American manufacture over those from other countries is due wholly to the fact that reliable, energetic, respectable, thoroughly trained men were sent here to introduce them. The same applies to electrical and many other kinds of goods; and I may add that with such men in the field my own efforts are abundantly supplemented, whereas, previously, any effort I might make to influence trade was counterbalanced by the neglect or inability of salesmen."

The Record Run of the Westinghouse Turbine.

The remarkable continuous run of the Westinghouse steam turbine at the St. Louis Exposition deserves a conspicuous place in the permanent record of steam engineering. This 600 horse-power turbine was started in the Palace of Machinery at 9:20 a. m., June 20, and was stopped at 11:32 a. m., December 2, the elapsed time being 3,962 hours. As the speed maintained was 3,600 turns per minute, the total number of rotations was 855,792,000, or approaching the billion mark. The work done varied from 25 per cent. underload to 25 per cent. overload. The turbine, after its stoppage, was examined by a responsible committee and was found in perfect condition, with practically no wear discoverable, the tool marks still remaining on the bearings. There have been at least two instances in America in which reciprocating piston engines have been run continuously for as long a period as in this record run of the Westinghouse turbine, but, of course, the speed of rotation was not one-tenth as great. We printed in 1903 (page 1695) an account from New South Wales of a continuous run of six years by a 250 horse-power compound condensing engine, built in Leeds, England. It seems to be possible to run engines as long as may be required except for wear or breakage, and the steam turbine minimizes these contingencies.

FIG. 2. YARD WORK.

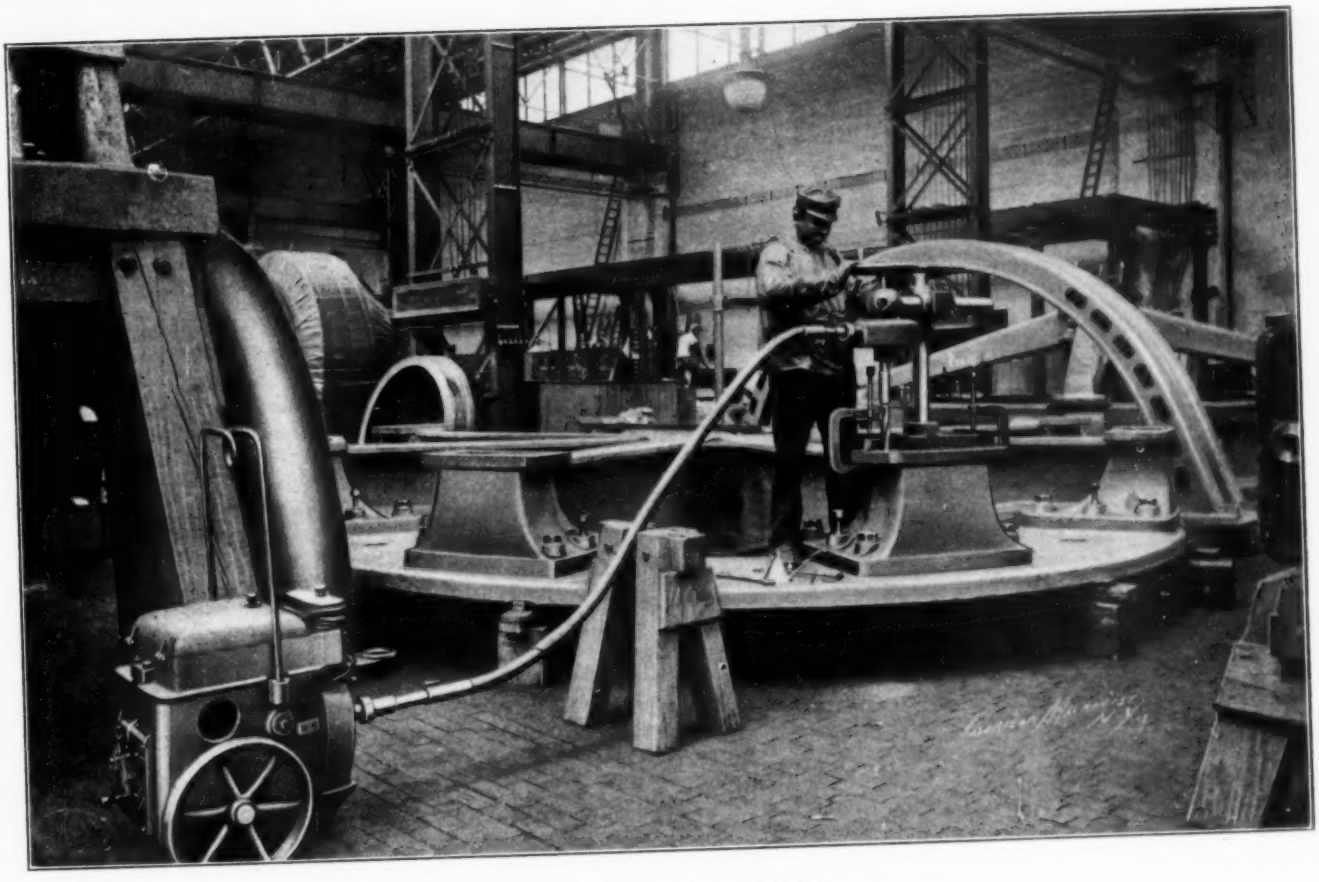


FIG. 3. HEAVY FLOOR DRILLING.

A Home Study Course.

BY ERNEST M'CULLOUGH, C. E.*

It is a mistake on the part of a young man who can remain in school to wish to leave it too soon, thinking he can do his studying after working hours. The young man who wishes to pursue any branch of engineering work should get the best possible education before going into the shop or drafting office. Many cannot, however, stay in school after their fourteenth or fifteenth year, and if they wish to advance it is an absolute necessity for them to continue their studies after supper.

"Every moment you now lose is so much character and advantage lost; as, on the other hand, every moment you now employ usefully is so much time wisely laid out at a prodigious interest."—*Lord Chesterfield to his son.*

The foregoing advice should be printed on a good-sized card and hung in a prominent place in the young man's room, and on all the vacant spaces on the wall it might not be a bad idea to stencil in large letters, "DO IT NOW," or it might be varied with a motto which hangs in a large drafting room, "If you have the time to-day use it on to-morrow's job."

INTELLIGENT SELECTION OF BOOKS.

The young man studying by himself is inclined to put off and procrastinate. He hates himself while he is losing good time, but it becomes a habit after a while. The reason is principally that he lacks competent advice and is advised to buy books which he finds later on are not suited for self-instruction or are not worth the money.

I was in a bookstore the other day when two young fellows came in looking for a book on mechanical drawing. The clerk showed them a certain book.

"No, I have that and it is mostly copying. I want something different."

The clerk took down another book. "This," said he, "is used in all the schools around here. They use it in the Manual Training School and the High School and in the evening classes of several schools. I guess it is just what you want."

Just then he was called away and the boys were left with the book in their hands. They looked it thru and, catching sight of some mathematical explanations and some plates showing how to develop queer surfaces, put it back.

The clerk came back but could not help them. They did not know what they wanted exactly and he had no more idea of their wants than a man from the moon. He was a good clerk in any bookstore, but could not advise young men who did not know what they wanted. There is no doubt that he could fairly well gage the quantity of books the firm could sell and in the course of a year would have made a good showing as to the movement of books off the shelves in his department. I, however, saw on the shelves just fifty-seven books which it is a sin to palm off on men looking for right information which is up to date. The clerk, in conversation, said those books were good sellers.

The young fellows asked me if I could tell them what books to buy. I talked with them and found out what they wanted. They were apprenticed machinists and wanted to know something about drawings so they could understand them better in the shop and some day might want to make drawings for themselves. They, however, did not want positions in the drafting office and frankly said they did not think they had sense enough to get a good education.

I advised them to stay with the book they had which they complained was simply full of drawings to copy. I explained to them the value of the exercises in it and showed that it was only by continual practise they could gain any facility and that by getting at the thing in the way the book went at it they could soon understand how to read drawings. It was as I suspected. A term was used on the first sketch which they did not understand and they could not find explained in the book. It was "the pitch of the rivets." When told that it merely meant the distance between centers they looked sheepish. I told them "If you had copied the drawing and

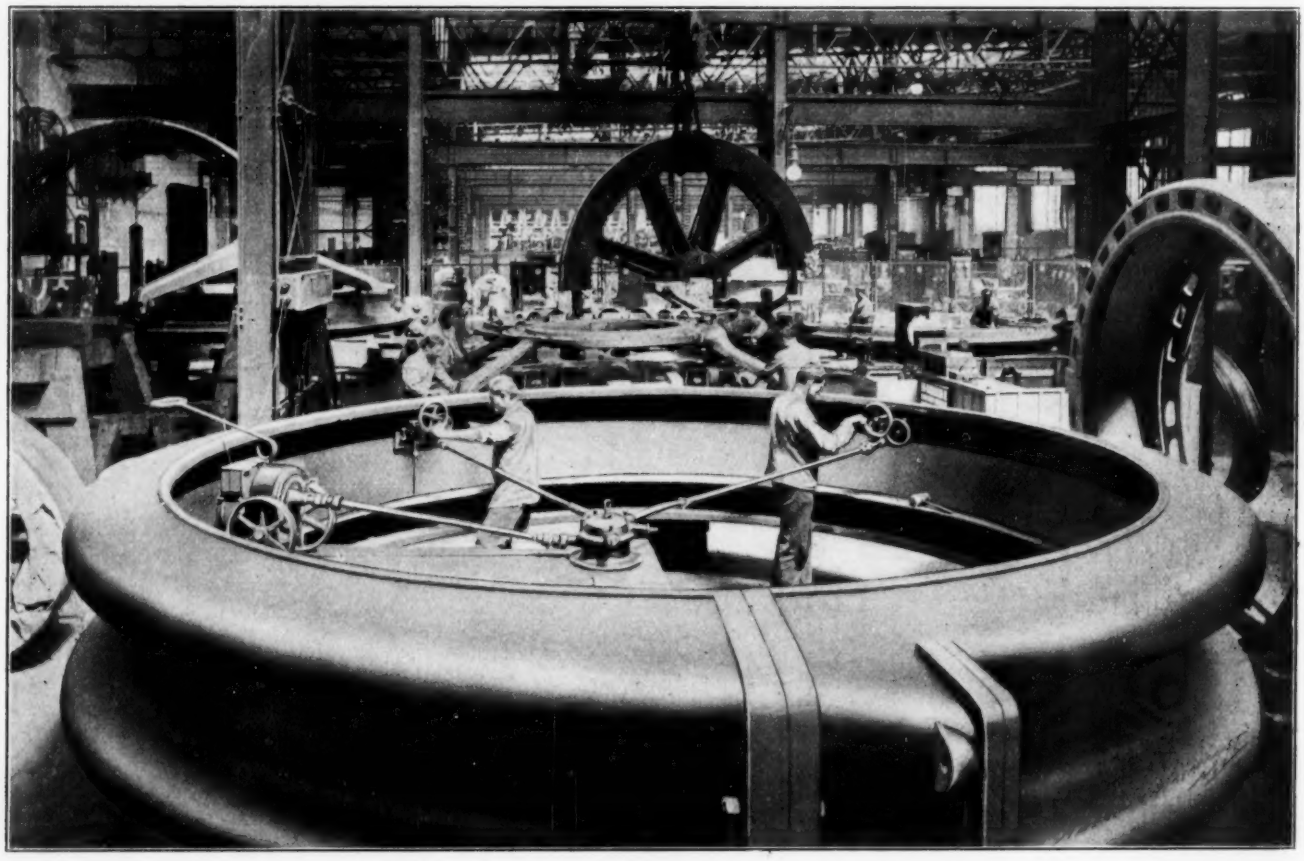


FIG. 4. CENTRAL STATION DRILL.

*Mem. Western Soc. Eng.

made it according to dimensions, you would soon have caught on to the meaning of the term."

They wanted a little information about machine design, but dreaded mathematics. It reminds one, when he meets such cases, of the old song,

"'Mother, may I go out to swim?' 'Yes, my darling daughter. Hang your clothes on a hickory limb, but don't go near the water.'"

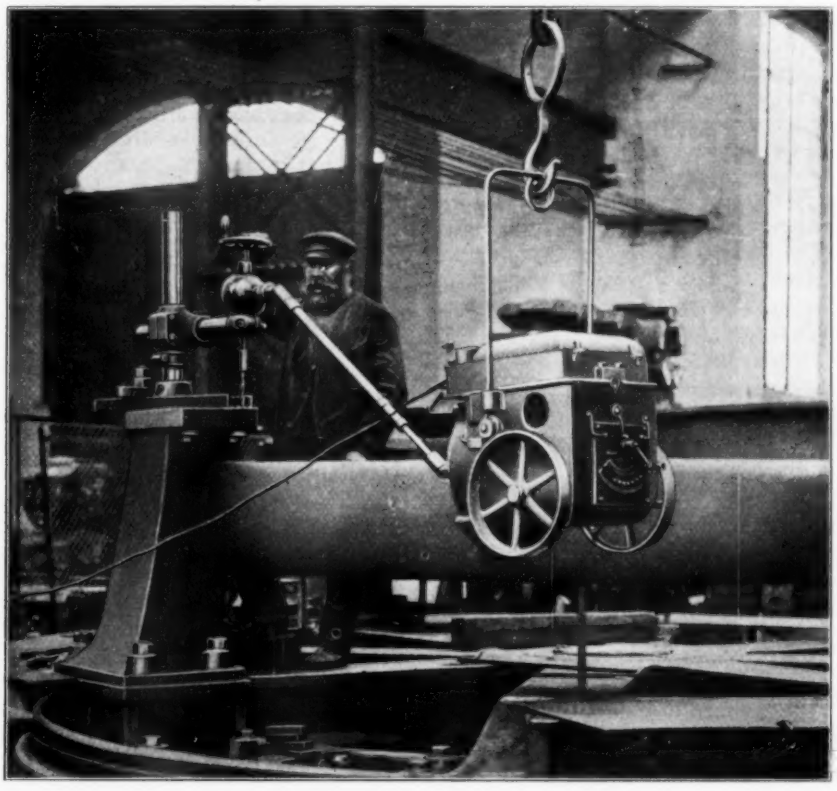


FIG. 5. SUSPENDED MOTOR.

The clerk jumped in with some books containing the word "easy" in the title. "Shucks," said one, "I have a trunkful of books like that. The only easy thing about them is the feller that buys them."

A little more conversation was had, and on my advice they went away with a copy of "Workshop Mathematics" and went into the school-book department to buy a copy of "Wentworth's Elementary Arithmetic." The real trouble with those boys was that they wanted education handed to them and hated the grind which is necessary. They recognized their deficiencies and were sincere in the desire to overcome them, but it was hard work to study at night after a hard day's work and one or two friendly explanations and two or three enthusiastic conversations each week with a man who understood would have kept them up.

As they get older, things will gradually soak into their heads, and after a while they will take up some of their books and be surprised to see how simple certain parts really are. Then they will buckle to study again and have a busy spurt for a week or two, by spells. By the time they are fifty they will have accumulated a little stock of knowledge and swelled heads because they can do a little patter talk which less studious men think is wonderful.

There are other young fellows, however, possessed of a sincere desire to learn and with the dogged spirit of perseverance so necessary. These young men are in the same position as thousands of others. They have many books to select from, and no guide to tell them how to separate the good from the bad. Nine times out of ten they make poor selections and become discouraged.

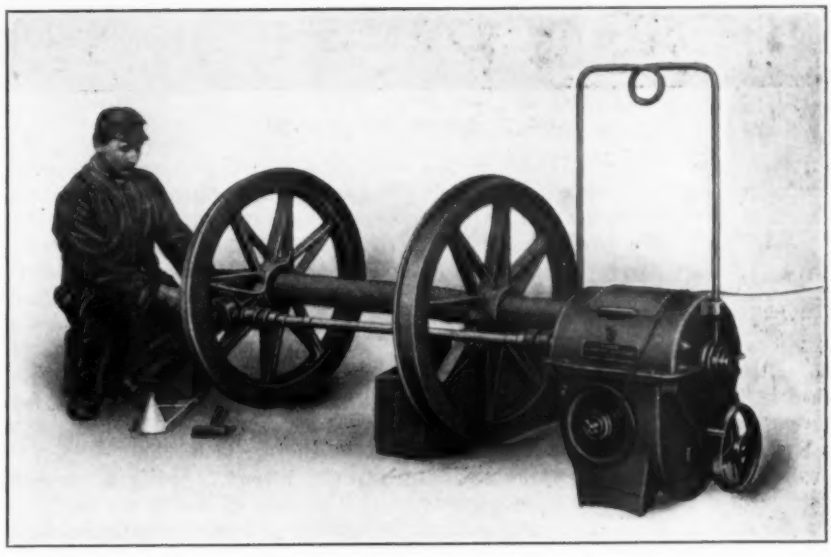


FIG. 6. DRILLING CAR-WHEEL HUBS.

ADVANTAGES AND DISADVANTAGES OF NIGHT SCHOOLS.

My advice is to go to a good night school if possible. The objections to night schools conducted by cities and different associations as a rule are these:

1. The fact that a night lost makes it very difficult for a man to regain his standing in class, therefore individual instruction is what is needed, but is practically impossible. The class method is also illy adapted for instruction when many of the pupils are slow thinkers, and it is necessarily the ones who see a point quickest who gain the most. The slow ones become discouraged.

2. The courses are generally arranged to cover two or three years and the lessons are graded. The man who wishes to go a little faster cannot do so, and if a large number drop out during the year it often happens the second year that there are not enough to justify the conductors of the school to engage the teacher for the advanced studies and the students ready for the higher work are left to shift pretty much for themselves with a little assistance from the overworked teacher who has the beginner's class.

3. The distances are sometimes considerable and in bad weather some lessons are missed. Other interruptions sometimes occur which prevent constant attendance.

Notwithstanding the above disadvantages and others which will readily occur to men who have received such instruction, night schools are of vast benefit to men who can attend them regularly.

ADVANTAGES AND DISADVANTAGES OF CORRESPONDENCE SCHOOLS.

Correspondence instruction of late years has received a wonderful amount of advertising and thousands of students have been benefited. A student in a correspondence school lacks the personal contact which counts for so much, but in spite of this he gains a great deal. I strongly advise young men to take courses

in correspondence schools if they cannot attend a resident course.

The great drawback to the correspondence school is the thoroughness attempted in the examinations on each lesson. It is sometimes a case of one evening spent in study and five or six spent in writing replies to the questions on the examination sheets. It is tedious to many and doubly so to the young man searching for the royal road to learning.

I judge from the few cases known to me and the many known to my friends, where correspondence courses were started and not completed, there must be a large proportion who never go far in their studies. Many stop because of the hard work and many because of ridicule. Since the funny paragrapher in the newspapers started to coin jokes about the postage-stamp seal on the diploma there has been a distinct chilling of enthusiasm. It has become the fashion in many places to make fun of the earnest correspondence student. I read a few months ago an advertisement in a large newspaper in which the advertiser wanted an electrician to take care of a plant and added "No applications considered from students of correspondence schools." That man was a fool.

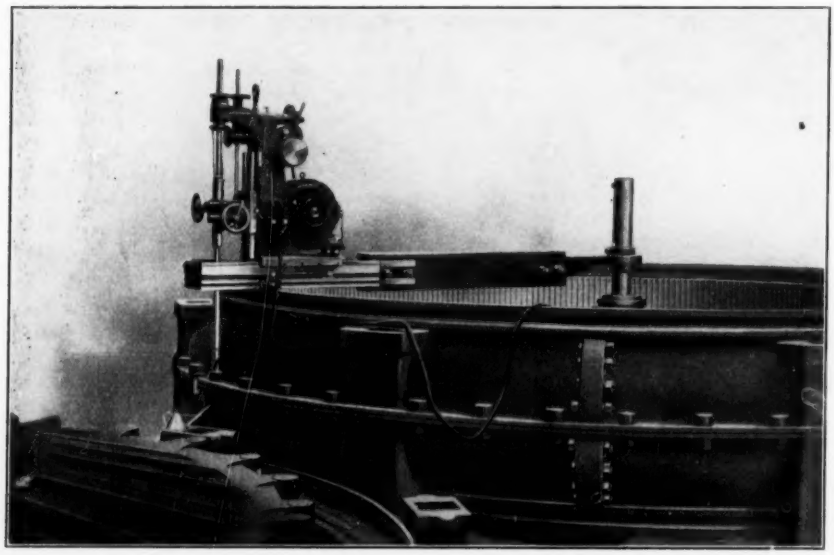


FIG. 7. RADIUS ARM DRILLING.

An examination of the text books and the methods used in the best of these schools will soon convince a man that the student gets the full worth of his money and something over. The word "correspondence" has been run into the ground. Many young fellows would take a course of study in a school giving correspondence courses without plastering the word over everything and using modest, quiet, stationery. As it is now, each student feels the proprietors of the school are taking an undue advantage of his position and from the postman on the street to every lodger in the house he has to run a gauntlet of good-natured chaffing that ultimately causes him to drop the whole business. There is an opening for a good school which will drop the tom-tom and red-banner methods of attracting followers.

STUDYING ALONE.

This article, however, is intended to discuss the case of the young man who cannot, or will not, attend a resident school and who cannot, or will not, take a correspondence course. For him, if he wishes to learn, there is nothing but downright hard dig, dig, dig.

It is lonesome and fearfully uphill work, with no one to stand by to help over hard places or give an encouraging pat on the back, no one to send lessons to for correction or approval, no one to recite to or to show with pride a completed piece of work. It is just plain hard work with the reward far in the future, beyond view.

The heart grows sick many a time and a dance occasionally is so tempting. A visit to the home of the girl is nice occasionally and a night off for the theater once in a while seems only proper. Then some day there is a chance for promotion and it hits another man. That night with heartburning the dust is brushed off the books and the lamp again lighted.

Sometimes the young chap gets married and hopes to realize the picture printed on the correspondence school circular, showing the faithful little wife and the olive branches so cosy and pleasant in the neatly arranged sitting room with papa in the foreground studying his lessons.

If the burner of midnight oil gets married it is the end of the study proposition nine times out of ten or the home is unhappy. It behooves the ambitious one therefore to advance as far as possible before he marries.

The most successful men are those who win against difficulties. The man who feels he has something to learn is busy acquiring knowledge and is bound to show it. His efforts to make up for lost opportunities take him to the front. Therefore the young man who resolutely pursues a course of study to make himself a better man in his chosen work has everything in his favor. His study is acquired along with his experience and the theory he learns is tested as he learns it.

LEARNING TO DRAW.

The first deficiency the young man realizes is his lack of ability to draw. So it is to study mechanical drawing his first wish is expressed. Here is where his troubles begin. In the first place he has difficulty in understanding just what is meant by mechanical drawing. He knows that when a mechanical draftsman is mentioned a man who can make drawings of machinery is meant. Yet when he buys a book on mechanical drawing he generally gets a book telling him how to use instruments and filled with problems in practical geometry, with perhaps a few pages in the back containing some instructions for making a drawing of a riveted plate or a kitchen table.

To define mechanical drawing it is easiest to describe it as follows: Mechanical drawing is not free-hand drawing. This definition should make it clear that mechanical drawing is done in a mechanical way. For the mechanical engineer a full course in mechanical drawing consists of:

Mechanical drawing, including practical geometry and descriptive geometry.

Machine drawing, which is what the apprentice terms mechanical drawing, and

Machine design.

In mentioning certain books as suitable for self-instruction I wish the following to be borne strictly in mind: 1. That I do not believe, and do not claim, the books mentioned to be the only books of their sort for a young man to study. 2. That no personal interest leads me to mention these books rather than others. 3. That I have no doubt other men will recommend other books covering the same ground which will do just as well.

What I do claim, however, is that the young fellow who wishes to pursue a connected course of home study has a hard time getting disinterested advice and spends many dollars foolishly before he finally gets on the right track. I have had a fairly good experience in teaching apprentices and selecting courses for home study and simply wish to do what I can to assist. Many men have pursued courses I have mapped out and expressed themselves as satisfied. It is better to start out with a plan and stick to it than to start out densely ignorant and change text books every time a friend talks slightingly of the ones you have.

THE FIRST BOOK.

The first book I put in the hands of the student is "An Introduction to Machine Drawing and Design," by David Allen Low. (Published by Longmans, Green & Co. 80 cents.)

This satisfies the man who wants to begin at once on machine drawing. To many it is like copying, and many make that

complaint, but to the ones who go at it in earnest great good results. By working out the drawings they absorb a vast amount of valuable knowledge about machine parts and proportions. The young man who starts in the drafting office by inking in drawings and making tracings does a deal of copying, but the knowledge gradually soaks in.

GEOMETRY.

The machine drawing is more interesting than the doing of problems in practical geometry, but one cannot go far before the need of a knowledge of geometrical construction is felt. For this reason I advise taking up the work in practical geometry at the same time and on a different night. Book 8 of Longman's New Series of Drawing Books is entitled "Practical Geometry." The price postpaid is 10 cents. It should be followed by Book 14, entitled "Plane Geometry" and costing 12 cents postpaid. Book 15, entitled "Solid Geometry," costs 17 cents postpaid. Have one night in the week to study this mechanical drawing and the following night for machine drawing. In this way the work is varied and becomes more interesting. If when these three small books are completed the student has become interested in that kind of study, he can take up "Descriptive Geometry," by L. Faunce (American Book Company, price $2.00). The study of descriptive geometry can, however, as well be taken up later.

It is a good plan when the three small books on practical geometry are completed to give the evening they took to the machine drawing, thus having two nights in the week for that.

When fair progress has been made in drawing the student should procure "The Technic of Mechanical Drawing," by Reinhart (published by *Engineering News,* price $1.00). This book gives particular information about lettering and the preparation of good drawings. It is not a treatise on mechanical drawing or machine design, but is simply what the title states, a book on technic, or what we would call "the way to do it right." The student of this book will certainly know how to make a first-class drawing and finish it in the most approved manner. It, however, like the descriptive geometry, can wait if the purse of the student or his time compels economy.

MATHEMATICS.

Before he can progress farther than the elementary work on machine drawing and take up machine design, he must possess a working knowledge of mathematics. This is where the stumbling block comes in. The word "mathematics" frightens many away. Still, if any progress is to be made in these days when the self-tutored man has to compete with the graduate of well-equipped technical schools he must know something more than mere mechanical drawing.

It is harder to select a book on mathematics for the self-tutored man than a book on any other subject. If the book is too large he will get weary, and if there are more than two books at the most he will become discouraged. Ordinary textbooks contain much that the self-tutored man does not need and much that few men need unless they are studying mathematics for the purpose of teaching the subject to others.

I recommend Castle's "Practical Mathematics" (published by Macmillan & Co., price 80 cents) as being adapted to the needs of self-tutored practical men. In places, however, the aid of a teacher will be almost an absolute necessity. The way to get over this difficulty is to buy for 60 cents Higgs' "Algebra Self Taught" (published by Spon & Chamberlain) and use it in connection with Castle. Higgs' work is fine on explanation, but shy on examples to work for the purpose of giving a man practise and making him proficient. One trouble with the study of mathematics is that most of it seems so like good common sense that a man will not trouble himself to work out all the examples; thinking he knows it well. When he does come up against a hard one in a subsequent chapter he finds himself lost.

PRACTISE PERFECTS.

Addition is very easy, but only long practise makes a man proficient. It is the doing of a thing over and over that makes a man skillful. It is not enough to simply understand and know how, but it is necessary to be able to perform. For this reason I recommend that every example be fully worked out. Do not spend too much time on hard ones, for they will discourage a man. After a sincere trial, let it go for the review. Go thru the book in this way and then go over it a second time. This time not an example should be passed. Use Higgs for reference and help. Work every example this second time and then go over the examples for examination in the back of the book.

Do not be too discouraged if things seem hard. Professor Ormsby tells of a teacher of mathematical subjects who used to say to his students that when a man begins to study mathematical science, if he meets with no difficulties he is one of two things. One of these two things, he said, was a genius. The name of the other he declined to state.

Professor Ormsby also says: "It has been written of a great mathematician that he once said that if he were given five minutes in which to solve a problem, he would spend three of the five in thinking how to do it."

After progressing in the study of mathematics past the solution of simple equations the student should add a fourth night of study and not exceed the limit. Four nights in a week should be sufficient. The other two nights can be given to rest and pleasure.

On the fourth night should be taken up the study of mechanics.* This should be studied in the same manner as mathematics. Go thru the book once very thoroughly and then a second time to fix the facts and work out the hard examples including the examination questions at the back. The book to take up is "The Elements of Physics," by Henry Crew (published by Macmillan & Co., price $1.10). This book is to be studied from cover to cover.

It not only treats of mechanics, but of physical science, including electricity and magnetism. The student will need this knowledge all thru life.

The student now has practical geometry, machine drawing, elementary practical mathematics and physics under way, and is supposed to be studying four nights each week about two hours per night. When one subject is completed, let him devote the night given to that to some other of the subjects he has in hand until he completes them all.

I have had an extended experience in the offices of civil and mechanical engineers, architects, land, mining and railroad companies and can say that with the exception of drawings intended for show purposes or to be reproduced by photography not 1 per cent. of the drawings made are inked in. The usual practise is to make the drawing in lead pencil on a smooth-surfaced, buff-colored paper and trace it in ink on tracing cloth. The paper drawing is sometimes kept, but generally destroyed when the tracing is completed.

The student can take a hint from this and save himself a great deal of time. Be neat. Cut the paper with square corners and smooth edges. Draw a border line around just half an inch from each edge. Keep all the drawings and titles inside the border. Draw each part as nearly as possible in its relative position and at an angle it assumes in the completed work. Make the drawings in lead pencil and do not use up valuable time inking them in. Draw on both sides of the sheets and economize paper. When thru take the most complicated drawing and trace it on tracing cloth for the practise. Trace two or three drawings and then when fairly good at that ink in and finish one of the paper drawings.

THE ADVANCED HOME COURSE.

The elementary stage completed, the student should now take up "Graphical Calculus," by Arthur H. Barker (published by Longmans, Green & Co., price $1.50) and follow it with "Mechanics Applied to Engineering," by John Goodman (published by Longmans, Green & Co., price $2.00). These books for Monday night.

For Tuesday take up "Materials of Machines," by A. W. Smith (McClurg & Co., Chicago, $1.00) and follow that with "Strength of Materials," by Mansfield Merriman (Wiley & Sons, New York, $1.00).

For Wednesday night take up "The Essentials of Gearing," by G. C. Anthony

*The author here means mechanics as a branch of physics or natural philosophy, not the study of machinery as such.—Ed.

(McClurg & Co., $1.50) and follow it with "An Elementary Text-Book of Machine Design—A Study of Method, with numerous illustrations" (sold by the author, Prof. Charles Lewis Griffen, Syracuse, N. Y., price $2.50). This book is very helpful as indicating the methods by which a designer of machines goes at his work. It, however, needs for its complete understanding all the mathematics, physics and machine drawing heretofore outlined.

For Thursday night take up "Steam," by William Ripper (Longmans, Green & Co., price 80 cents). This book is to be thoroughly studied twice. Follow it with "Steam Power Plants, Their Design and Construction," by H. C. Meyer (McGraw Publishing Company, New York, price $2.00), and next "The Mechanical Engineering of Power Plants," by Professor Hutton (Wiley & Sons, price $5.00).

This completes the intermediate stage. When the books mentioned for a particular night are finished, use that night for one of the other studies and thus keep occupied four nights in the week. It may be that after a while the four nights will be all occupied with one subject.

When the intermediate stage is completed the student is ready for the final or senior course. He should take up first the study of engines, and for this the book is "The Steam Engine," by Professor Perry (McClurg & Co., price $3.50) and "Steam Boilers," by Professors Parsons, of Troy (Wiley & Sons, price $4.00).

Having progressed to this point, the student can be left to himself. He will have a good knowledge of mathematics and mechanics, strength of materials, etc., and be able to read any technical book published and judge for himself as to its possible value. It is quite possible he will be engaged in some specialty in mechanical engineering and require special textbooks. The head draftsman, or his employer, can no doubt guide him in a selection.

In many of the books the student will find information he has already obtained in a book previously studied in the course. He should not skip it for this reason, but study it and refer to the other books. It is well to know more than one way of presenting a subject. For example, some information on the materials of engineering may be found in nearly every book and certain principles of mechanism will be found fully stated in nearly every book. This is no drawback, but rather an advantage for the useful review it gives.

During his whole course of systematic study it is supposed the student is a subscriber to the AMERICAN MACHINIST and perhaps other technical papers and will thus keep track of current progress. When he begins his studies he should purchase for $2.00 "Extracts from Chordal's Letters," and read it on the cars to and from his work and on the two odd evenings in the week and at such other times as he can until he knows the book by heart.

When his drawing office experience begins he should supply himself with a copy of "The Mechanical Engineer's Reference Book," by H. H. Suplee (*Engineering Magazine*, New York, price $5.00).

"How much good will it do me to study such subjects if I am not naturally adapted for such work and am not a mechanical genius?" asked a young man.

"What do you want?" was the reply. "Is there any other work you prefer?"

"No. I am very anxious to learn all I can about mechanical engineering, but I know I am not as bright on such subjects as lots of other fellows. In fact, I feel discouraged when I get with a lot of fellows who seem to be naturally fitted for careers as mechanical engineers, and yet I care more for it than they do. They see things more quickly than I do, but are satisfied with what they know. I often think it a pity I do not possess more insight together with my desire. I am not a mechanical genius, yet I want to be a mechanical engineer. Do you think a career as a grocer's clerk would be better for me?"

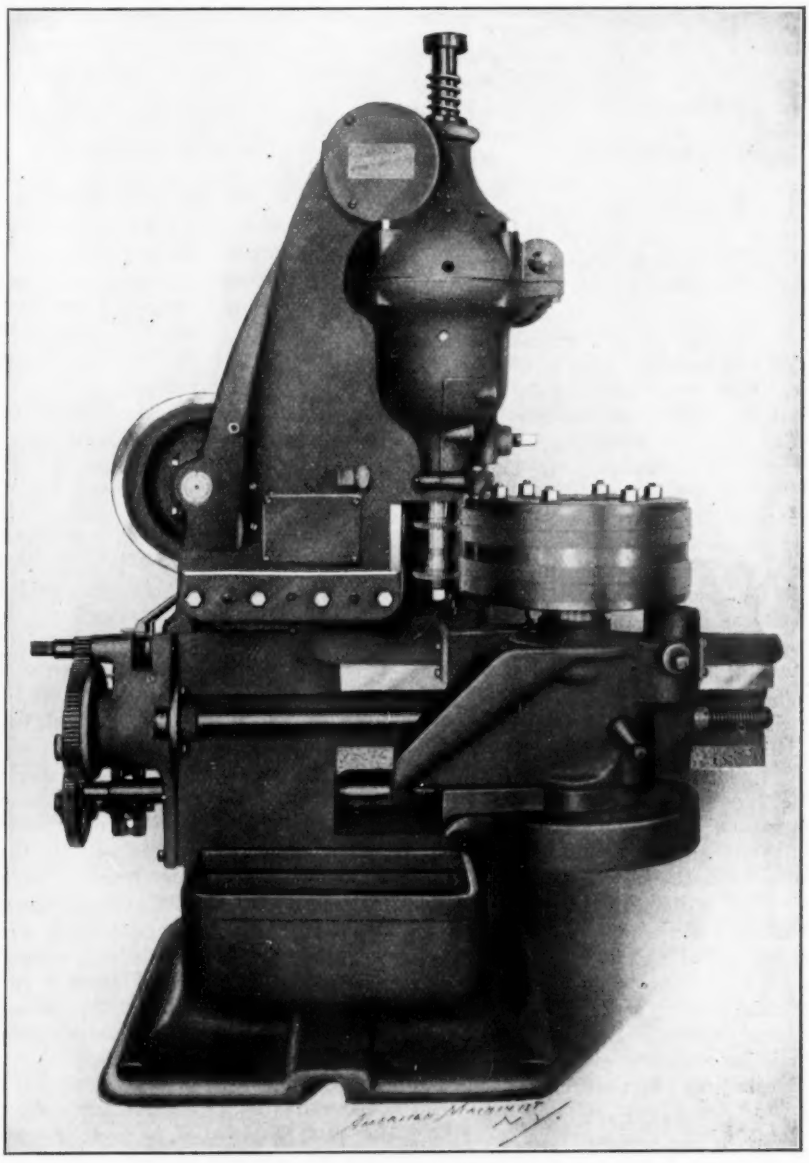


FIG. 1. GEAR SHAPER EQUIPPED WITH TANDEM CUTTERS.

THE EDUCATION OF A CHECKER PLAYER.

"Your inquiries can best be answered by telling you a story of Bill Jenkins with whom I went to school. Bill was dull and could never master any of the games we played. He wanted to play with us, but was never wanted and we ran games short handed sooner than include him. Finally he was left to play checkers with the village checker champion, who played with him simply to practise new moves. Bill never won a game even when he could induce some other person to play with him.

"He got discouraged finally and played doggedly with little boys, whom he sometimes gave a nickel to play checkers with him. He never could get on to the game somehow, altho it seemed a simple thing to move the pieces around. He asked the checker champion who taught him, and was told grandly that good checker players were born. He asked if there were any

books on the game and was told no. He was told that if he wanted a game to learn out of books to study chess. So he sent for an instruction book on chess and it stumped him. In the back, however, he found an advertisement of a book on checkers and sent for it.

"He found it was full of columns of figures giving moves in games. He played these games by himself in his room and saw that it was a matter of memory simply. Well, that fellow studied that book till he had memorized about twenty complete games and a hundred or more side steps and side combinations. There wasn't a move the village genius could make that Bill did not have a knowledge of. Then he sallied out for laurels. The village genius fell and then others from neighboring villages fell. Bill became the champion of that section of the State and the power of education properly applied when pitted against unaided native genius was never better exemplified.

"Bill never told that he was an educated checker player, but his sister once found his book and spoke of it. The discredited village genius sent for a copy and soaked himself full of combinations as Bill had done. Then he issued a challenge and Bill accepted. The village genius was now an educated man who had added his education to a natural talent for the game. He should have beaten Bill but he did not, for Bill had had his wits sharpened by his continual practise after his book learning had been completed and his trained mind was as good as that of the other fellow. In a series of games played the first winter after their education was done they stood about even. They are playing checkers every night now and have been at it twenty years. They will keep at it till they die. They are about equal in ability.

"It is just possible that a man with a good education in a chosen line of work will be as well fitted for it as a man naturally gifted but without the education. Yet if compelled to compete with an educated man who is also naturally gifted, the continual putting the principles learned into practise with conscious effort may more than compensate for any lack of untrained intuition."

Gear Shaper With Tandem Cutters.

The illustrations represent the new 24-inch machine of the Fellows Gear Shaper Company, of Springfield, Vt., as arranged for the rapid machining of gears thru the medium of two cutters placed tandem fashion on the spindle, and hence operating simultaneously on two blanks or two sets of blanks. This machine (described fully at page 1844, Vol. 26) has a cutter spindle stroke of approximately 4 inches; in the adaptation to the use of double cutters without increasing the width of the gap under the head, the maximum stroke is of course reduced by one-half, or to 2 inches. The cutters in operation on two pairs of gears are clearly represented in Fig. 1, and the method of mounting these cutters and the scheme for holding the gear blanks are shown in the sectional views in Fig. 2.

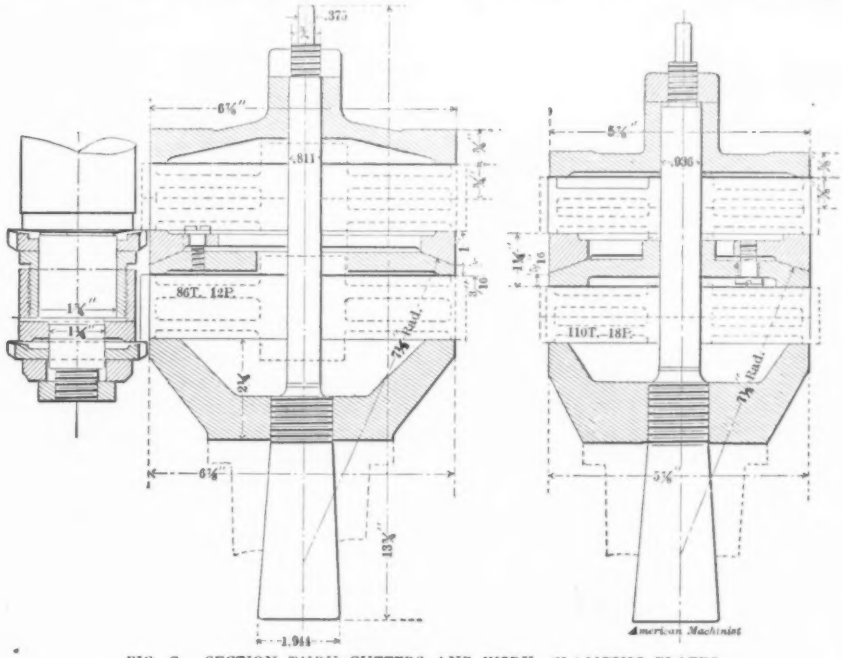


FIG. 2. SECTION THRU CUTTERS AND WORK CLAMPING PLATES.

The lower of the two cutters is the regular gear shaper cutter in all respects; the upper is of the same diameter, but has a 1¾-inch bore, thus allowing the cutter spindle to be left large enough at the reduced portion to prevent springing under the action of the cut. The spindle is further stiffened by hardening, after which it is ground to slide directly in the bore of the head, as explained in the article referred to above. The cutters are spaced the proper distance apart by adjustable collars.

The clamp plates for the work are so constructed that any slight irregularity in the thickness of the rims will not spring the clamping apparatus, and hence throw the work out when several blanks are placed together on the arbor. It will be noticed that the plate separating the two sets of blanks is formed with a spherical joint allowing the upper and lower halves of the plate to adjust themselves to the blanks at either side; at the same time the work arbor is very slightly smaller in diameter than the bore of the gears; consequently, as the clamping nut at the top is tightened, the gear rims may come solidly together without cramping and springing the arbor.

The two sizes of gears shown in the line drawings are for use on cream separator work, as are also those in the machine in the half-tone. The latter, however, are of such a size that a series of clamping studs and nuts is used in place of the single nut on the arbor in Fig. 2. The gears, as shown by the dotted lines in the drawing, are 6 2-18 and 7 2-12 inches pitch diameter, 5/8- and ¾-inch face, and 18 and 12 diametral pitch respectively. The 18-pitch gears were shaped with this arrangement of cutters at the rate of ninety per day of ten hours, the time on the larger work being increased in exact proportion to increased diameter and pitch.

Ramie.

An advocate of ramie as "the textile of the future," writing in the *Indian Textile Journal*, claims for it the following advantages:

1. It is many times stronger than cotton, flax, hemp, and the like.

2. It has a very long staple, from 3 to 9 inches.

3. It is easily grown, as it acclimatizes itself in almost any zone, where agriculture is possible of course, with varying results, as it crops in some latitudes as many as four times per annum.

4. It is beautifully lustrous, more after the nature of silk in appearance.

5. It does not rot, giving it, for many purposes, such as fishing lines, nets, sail cloths, boot and saddlery thread, tarpaulins, rick cloths, tents, hose, shop blinds, boot linings and other requirements necessitating exposure to damp, great advantages.

6. It is non-elastic, and herein it is invaluable for machinery belting and ropes, measuring tapes; mixed with wool, it imparts non-shrinking possibilities to that article and many other purposes where rigidity is an advantage.

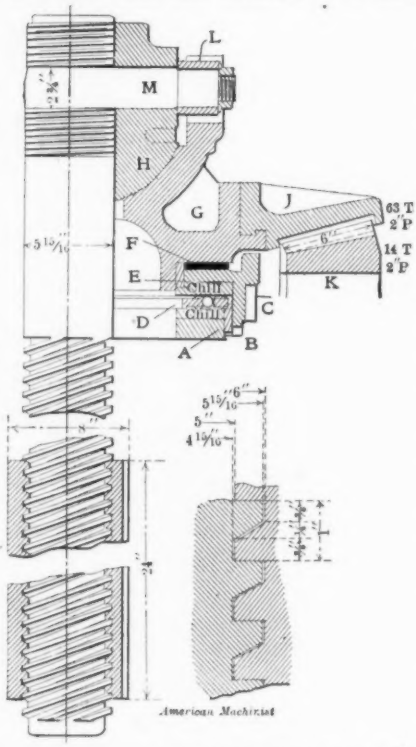
The breaking of a governor belt in Toronto, Canada, recently, allowing the engine to run away, caused the flywheel to burst, killing a man 200 yards away while the engineer and another employee nearby were uninjured.

Notes on Cranes--A Screw Hoist.

BY A. D. WILLIAMS.

Very few screw hoist cranes have been built. They are generally employed for handling ladles of molten steel, and have two screws which hang vertically from the trolley, one on each side of the crane bridge. The screws revolve in nuts which are held from turning by hollow casings extending upward from a cross piece or bail, from which the ladle hangers or hooks depend. The hollow casings holding the nuts are made oil tight, the intention being that the screws will thus be kept well lubricated. Dust guards are usually hung around the screws which telescope over the lower tubes. In practise most of the work is done with the lower part of the screws and they do not dip into the oil to any large extent. Furthermore, in steel plants in particular, this oil gets used up and the crane operator does not think of renewing the supply. The lower ends of the dust guards are open around the hoist tubes and some of the dust from the casting pit will work into the nuts. This does not hurt the screw very much, but it gradually cuts out the nut, and it is rather difficult to tell exactly what is left of the thread without dismantling this part of the crane, which it is not very easy to do and is therefore likely to be neglected. It is also difficult to put in new nuts in the scant time available under ordinary operating conditions of open-hearth plants, and the attempt to postpone such repairs is very likely to result in stripping a nut and losing a cast, if nothing worse.

The accompanying sketch shows one screw, of a double screw hoist of 60 tons capacity, together with the nut and the manner in which the screw was supported. The lower ring *A* rested on a casting supported by the trolley framing, this casting also carrying the pawls for the load brake. The upper surface of ring *A* was chilled and ground and acted as a ball race. There were one hundred and forty-four ¾-inch balls in the ball bearing, which were arranged in spirals in a brass washer *D*. A brass sleeve *B* encircled *A* and held the pawl ring *C* concentric with it. The pawl ring *C* revolved upon the ball bearing when hoisting; when lowering it was caught by the pawls and held stationary, the socket *G* in this case moving on the fiber friction washer *F*. The steel driving pinion *K* was on a cross shaft which drove both screws and was driven by the motor. The bevel gear *J* was of gray iron and was secured to the socket *G* by a key and held from rising by several cap-screws. A brass sleeve *E* centered *G* in the pawl ring *C*. *G* and *H* formed a ball and socket joint which allowed the screw to swing slightly as the crane moved. The pin *M* and bushings *L* formed a universal joint thru which the screw was driven. There were two screws, one with right-, the other with left-hand threads. The main hoisting nuts were of bronze. The hoist of this crane was about 20 feet. One of the ball bearings on this crane stood the racket very well, but the other failed in a short time, the balls cutting into both washers until all the weight came on the brass washer *D;* after this the ring *C* remained stationary and both hoisting and lowering were done on the fiber washer *F*, which was grooved on both faces, the grooves forming a letter *X*, one part of which was on each face. Holes were drilled in the washer at the points of intersection. Grease was supplied by compression cups from above. The thread on the screws was of the buttress type, as shown in the detail view, and was of 1 inch pitch and 4 inches lead, there being four threads. The screws were cut and the nuts bored and threaded in a lathe



SCREW AND DRIVING CONNECTIONS FOR A 60-TON HOIST.

which was specially rigged up for it, an index-plate and latch spacing the threads and the lead screw being driven by a special train of gears from the spindle to secure the proper lead.

The following is told by the *Gastonia* (N. C.) *News:*

After the rain the other day the High Shoal mill had to be stopped to get the eels out of the water-wheel. There is an old saying that eels go to sea after the first rain in November. This saying seems to be verified by the experience of the High Shoals people. The large water-wheels got so full of eels that they would not run. The mill was stopped and eels were taken out in large quantities all sizes. They were in the water cups and were wound around shafting till they were stretched to death.

The Organization and Methods of a Modern Industrial Works.*

The Baldwin Locomotive Works, in Philadelphia, is probably as good an example of a modern industrial works as we have in the country, and as I have been connected with this company for some years I will endeavor to give you an idea of how the plant is operated.

The Baldwin Locomotive Works, at the present time, employ about 15,500 men, who are divided among twenty departments. The executive force consists of one superintendent, four assistant superintendents and twenty foremen. Owing to the extent of the works it is divided into two divisions, the eastern embracing all shops east of Fifteenth street, and the western division taking in all shops west of Fifteenth street, also new shops located at Twenty-sixth, Twenty-seventh and Twenty-eighth streets. Each division is in charge of an assistant superintendent, who works in conjunction with the foreman in his division.

In the eastern division the most important shop is the erecting or finishing shop, located at Broad and Spring Garden streets. This shop employs about 2,500 men, and has a capacity of fifty finished locomotives every week. To operate this department we have one foreman, two assistant foremen and twenty track foremen. Every track foreman is a specialist on a certain line, such as erecting, valve setting, testing, etc., and has direct charge of the gang bosses and men who work under his supervision. The gang bosses, or contractors as we call them, are all picked men, the very best we can find, and have direct charge of the workmen. This same system of contracts is employed in every department throughout the works.

I will now explain our contract or piece-work system. Every department is a factory, manufacturing a certain number of locomotive parts. Thru careful study we are able to ascertain the exact time and expense involved in making these parts; we then allow a certain amount of profit for the contractor in making price; he, in turn, gives out his work—piece work—to his men at a slightly lower rate and makes the difference. There is a great diversity of opinion among manufacturers about the best way to pay labor. Some claim that you do not get the best results from the piece-work system because a piece-worker knows that he will not be allowed to make over a certain amount, and if he finds that he is making too much he will curtail his output sooner than run the chance of having his prices cut. This is true in some cases, but, under careful management, on routine work cannot occur. We expect and get more work per man out of our piece-workers than any similar concern in the world, and our men are allowed to make higher wages, and

*J. Wilmer Hennsey, in *Journal of the Franklin Institute.*

this, to my mind, explains why we never have strikes at Baldwin's.

In hiring a man we never ask whether he belongs to a union or not. We don't care. If he enters our employ he abides by our rules and regulations, which are posted in every department, and any attempt to incite trouble or dissatisfaction among the men is reported at once by his contractor and the man is dismissed.

A question that is often asked is, "Do you not have great trouble in procuring workmen who are skilled in the special lines of locomotive works?" We do. This is the question to which the Baldwin firm has given a great deal of attention in the past four years, and has led to the revival in our works of the old apprenticeship system, a brief outline of which may be interesting.

The apprentices are divided into three classes, first, second, and third. To be a first-class apprentice a boy must be seventeen years old and must have at least a grammar-school education. He serves four years. During this time he is allowed to stay on one class of work only three months, and is moved from department to department until he covers the entire plant. During the school season he is obliged to attend night school two nights a week, taking up a special course in higher mathematics and mechanical drawing. He is paid from $3.00 to $6.60 per week during apprenticeship, and on completion of time receives a certificate and $250. A second-class apprentice must be a high-school graduate and serve three years on same lines as first-class apprentice. He also attends night school. He gets from $4.20 to $6.60 per week, and on completion of time receives a certificate and $200. A third-class apprentice must be a graduate of a recognized technical school. He serves two years and does not take a night course. He gets from $9.00 to $12.00 per week and receives a certificate on completion of time.

We now have between 400 and 500 apprentices of the several classes, and it is proving of vast benefit to the works in providing a more intelligent and better class of labor than it is possible to get in any other way.

We claim that whether the apprentice stays with us or not on the completion of his time, he will always be a friend to the Baldwin Locomotive Works and look out for our interests, just as a college man does for his college. His training has made him a valuable man for railroad work, and one who will get ahead. It is a far-sighted business proposition.

A manager of a large shop has many other important matters to look after. If he is a progressive man, backed by a progressive firm, he wants to know the quickest and best way to get out work. Our firm encourages this among the foremen, and sends them all over the country to see how other people do work. If a foreman can prove that by the use of certain tools and appliances he can save time and expense, they are furnished him without question. During the past five years enormous strides have been made in this direction. By the aid of improved hydraulic and pneumatic tools hand work has been reduced to a minimum, and on this alone nearly $1,000,000 a year is being saved on the cost of work in the shops. We have also made great savings on time required to do the work by the use of specially treated tool steel for machine tools. By means of these tools we have been able to increase the capacity of some of our machines from 30 to 50 per cent. Our best results have been obtained from the Burgess Special Steel and the Sanderson Special Steel. All our new tools are being made from these steels, as ordinary tool steel will not stand the high speeds at which our tools are now being run.

It is interesting to see the vast difference between an up-to-date railroad or locomotive shop in this country and a similar shop on the other side. It has been my opportunity to visit a number of these shops in England, Sweden, Finland and Russia, and it is surprising to note the condition of their equipment. Power cranes are very rare even in the larger shops, and the machinery is of a type in use here twenty-five or thirty years ago. It is not strange, noting these conditions, that we can build locomotives in Philadelphia, ship them to any country in Europe, and put them in service on their railroads, 10 to 20 per cent. cheaper than they can build in their own shops.

As orders for locomotives are received, they are printed on lists and put out in the shops. Each list contains two weeks' work; they are dated with delivery dates for each class of work in the various departments.

The designation of the different classes of locomotives as used by the Baldwin Locomotive Works embodies the combination of certain figures with one of the letters *A*, *B*, *C*, *D*, *E* and *F*, to indicate both the number and kind of wheels and the size of cylinders. Thus, a locomotive having one pair of drivers is classed *B*; that with two pairs, *C*; that with three pairs, *D*; that with four pairs, *E*, and that with five pairs, *F*. The letter *A* is used for a special class of high-speed locomotive with a single pair of drivers. A figure 4, 6, 8, 10, 12 or 14 is used as an initial figure to indicate the total number of wheels under a locomotive. A figure or figures following the initial figure indicates diameter of cylinders, and the figure or figures following a class designation represents the consecutive class number of a locomotive on which it appears. Thus, 8 16 *C* 500 indicates a locomotive with eight wheels in all, having cylinders 16 inches in diameter with two pairs of driving wheels, and the No. 500 locomotive of its class. As soon as lists are put out, the drawing rooms get them and start at once to design the locomotive, furnishing bills of material to the purchasing department, which orders all material we do not make. Lists are furnished also to every foreman and contractor in the entire plant. The great advantage of these lists is that every man in the entire works is after the material he needs long before it is wanted in the erecting shop, and we are rarely subjected to delay on delivery dates. Every foreman has a book of lists—check-books we call them—in which he keeps an exact daily check of every piece of work made in his department. He, in turn, checks off the superintendents', who can tell by their books at a glance the exact condition of every locomotive part in the entire works.

An important factor in the management of a large plant is the system of accounts. The Baldwin Locomotive Works keep two sets of accounts, viz.:

(1) Manufacturing account.

(2) Commercial or financial accounts.

In the manufacturing books a ledger account is kept with each locomotive constructed and with each repair-work job. All materials and labor are charged to these accounts, either directly or eventually on closing the books. The principle is that no material or labor is paid for without being charged to an appropriate account.

In the commercial books accounts of dealings with individuals and corporations are kept in the ordinary way. Both sets of books are closed annually and correspond exactly in their statements of expenditures and receipts.

System of manufacturing accounts:

In the general system of accounts by which the cost of construction of locomotives is ascertained each locomotive is charged as follows:

A—*Materials.*—All materials used in construction of the locomotives at the actual cost as fixed in the general contracts covering such purchases, or as paid for same at market rates.

B—*Distributed Labor.*—All labor charged directly to the locomotives at actual cost of same, either by piece-work or day-work rate.

C—*Expenses.*—All labor and materials incident to the construction of the locomotives, but which from their character cannot be charged direct. The cost of these is distributed to the locomotives in the proportion fixed by the amount of distributed labor as per paragraph B. Until this proportion is finally determined for each year it is based upon the accounts for the preceding year. The expenses include wages of managers, foremen, clerks, draftsmen, stationary engineers, teamsters, laborers, watchmen, traveling engineers and messengers. They also include heating, lighting, repairs, insurance, taxes and other expenses on buildings and tools, patterns and dies, defective work, printing, advertising, traveling expenses and all incidental costs connected with manufacture.

D—*Disbursements for Freight and Delivering Locomotives.*—These consist of

railroad charges for transportation to point of delivery.

The aggregate of the foregoing items is the cost of manufacture and delivery of locomotives.

One of the most important departments and one whose influence is felt over the entire works is the test department. This is equipped with two Tinius Olsen testing machines for physical tests, and a complete chemical laboratory for chemical analyses, also with apparatus for indicating locomotives and stationary engines. Nearly all the material we use must first pass thru this department, and be reported on before being accepted; this applies to all boiler steel, spring steel, tank steel, bar iron, cylinder iron, steel castings, oils, paints, etc. We have fixed standards for all these materials which must be complied with before materials are accepted. The test department also has a corps of inspectors, who are stationed in the various rolling mills and steel plants we deal with, and whose duty it is to see that our mill specifications are lived up to, and that our orders are rushed thru.

One of the important duties of a shop manager is the care of machinery. The machines employed represent thousands of dollars, and it is of the utmost importance that they be kept in perfect repair. To accomplish this we have in every shop a machine inspector or tool boss. This man is an expert on repair work, and has a gang of machinists under his supervision. As soon as a machine breaks, the fact is reported to the tool boss, who repairs it at once. A number of duplicate pieces of the most breakable parts of machines are always kept in stock, so that the machines are seldom down but for a very short time.

In every large plant, especially one having large smith shops and foundries, there is a constant danger of fire; to overcome this we have, I think, one of the largest volunteer fire departments in the country, having about 200 picked men scattered all over the works. We have twelve large Barr pumps and as complete apparatus as the city department. Every shop also is equipped with a sprinkler system, and has stand-pipes and reels of hose on every floor. Every few weeks we have fire drills, and it is remarkable how quickly our men can get into service. They put out on an average two or three fires a month, and for several years have not had to call on the city fire department.

Another important matter is shop cleanliness. The sweepings must be run thru separators, then loaded on cars and sent to firms who buy all our turnings. Our sheet-iron scrap is carted to large scrap-bins built over railroad tracks in one of our yards. These bins have hinged bottoms, and when they are full, cars are run under them and loaded. This material also is sold, and proceeds from scrap and turnings amount to several hundred dollars a week.

The power of the works is handled by the highway department, which is responsible also for buildings, electric power and light and machinery repairs. We have four large power-houses, one at Broad street, one at Sixteenth street, one at Seventeenth street, and one at Twenty-seventh street, having thirty-one boilers generating 10,684 horse-power. Each power-house is in charge of a chief engineer, who makes a daily report to the highway office on a special form, giving an hourly account of steam and air pressures, and of the boilers, engines and compressors that were in service. By this means the foreman of the highway department is kept in contact with the power service throughout the entire works, and knows exactly how the pressures are being maintained at every hour of the day. We have 108 engines, pumps and air compressors, with 8,656 horse-power. All air compressors, dynamos for light and power and engines running them are located in power-houses, the other engines being located in the various shops.

As I have already stated, we employ 15,500 men, and to keep account of their time and wages is the work of our time department. Each man, on being hired, is given a number. The numbers for the men in each shop run in succession. Each contractor has a piece-work book, in which he keeps a daily account of the time and wages made by each man in his gang. The time of all day workers is kept in a day-work time book by the time clerk. Once a week the time department takes the time records from the piece-work and day-work books, entering the same on long printed sheets, giving the name and number of every man in each department. The piece-work books are gone over, and charges against each locomotive are entered to its cost account. The account of the wages due each man is then turned over to the pay department.

The pay department has pay envelopes stamped with the name and number of every man in the entire works. The amount of wages due is now stamped on each envelope. Our regular pay-day, with the exception of holidays, is on Friday, and every Friday morning the money is brought from the bank. It has always been our custom to pay in coin, which is easier to handle, and clerks are less liable to make mistakes. The amount stamped on each envelope is then put in, the envelope is sealed and all are arranged in succession, as to number, in an upright position, in specially constructed racks, each rack holding about 200 envelopes. These racks when filled are put in safes built for this purpose, and are now ready for the paymasters. We have two pay stations—one at Broad street, in the erecting shop, and another at Seventeenth and Hamilton streets. At the signal to quit work on Friday night the men arrange themselves in long lines, according to number, at their respective pay stations, and at five minutes after 6 the line starts. We have eight paymasters, and run eight lines, the foreman of each shop and his assistants having charge of the lines his men are in. Each man as he passes the pay desk calls out his number to his foreman and his name to the paymaster, who passes him his envelope. It is possible in this way to pay our entire force in thirty minutes.

In conclusion, I will say that, to my mind, to get the best results from a shop you must have a unity of feeling among your men. Every man should be treated as a man, not as a machine. If a man comes to tell you about a supposed or a real wrong, he should be listened to, and given the proper advice. Your superintendents and foremen should not be shut up in offices to which the ordinary workman cannot have access, but should be as get-at-able as possible. This is, and has been, the policy of the Baldwin Locomotive Works, and to this policy their success, I believe, may, in large measure, be attributed.

Standard Size Technical Journals.

H. L. Aldrich, publisher of *Marine Engineering* and of *The Boiler Maker*, calls our attention to the fact that these journals are both new recruits to the "standard size" ranks and are 9x12 inches. We are glad of it; the more technical journals there are that are standard size the more powerful will be the pressure upon others to adopt it, and eventually it will be quite possible for one who wishes to read, to bind, or to file a number of different technical journals to do so with much greater convenience than is possible with the present heterogenous collection of all sorts of sizes, most of which have no other basis than the fancy of the individual who happens to choose them.

By the way, *The Engineering and Mining Journal* may be added to the list, so that we now have

AMERICAN MACHINIST,
THE BOILER MAKER,
THE ENGINEERING AND MINING JOURNAL,
LOCOMOTIVE ENGINEERING, and
POWER,

all standard 9x12 inches.

We hope others will join and be numbered among "the elect." All but a few probably will do so before long.

The *Open Shop* publishes a form of agreement used by an unnamed manufacturing concern, which agreement is to be signed by men making application for work, and under which the employee agrees to give one week's notice of an intention to quit, but expressly agrees that he may be discharged at any time without notice. He also agrees that during the time he remains in their employ he will make no demand for an increase in wages, tho nothing is said about a reduction of wages. There would seem to be room for a little of the spirit of reciprocity in this, and we wonder if a firm using this kind of an agreement is really in need of first-class men, and whether or not it gets them.

Letters to the Editor.

A Modern Set of Drawing Instruments.

I have read Mr. Lyne's article on drawing instruments, at page 1150, Vol. 27, with interest, and should like to make a few remarks thereon.

In the first place, I think it is hardly necessary to have a separate instrument for pen and pencil in the 5½-inch compasses, as it is seldom they are used together. In fact, many draftsmen on original work could almost dispense with the pen. In Mr. Lyne's set there is no 3-inch compass after the same style of the 5½-inch size. There are the spring bows, which do very well for small circles, but for slightly larger work there is too much time lost in screwing them open and shut. Another thing I missed was the small handle on the top of the compasses, which is shown in Fig. 1 and which is a great convenience.

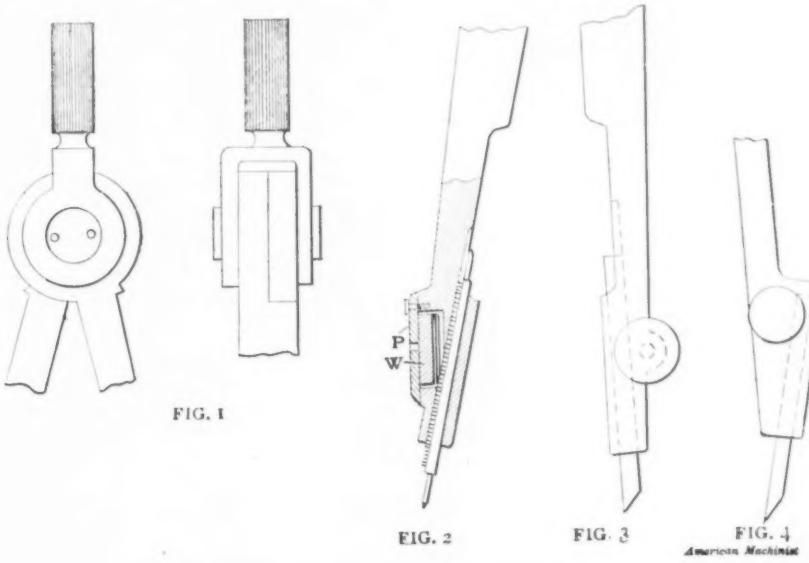


FIG. 1 FIG. 2 FIG. 3 FIG. 4

IMPROVEMENTS IN DRAWING INSTRUMENTS.

With regard to divider points, triangular ones rounded on the outside for about ⅛ inch from the point are much stiffer than round ones, and do not make holes in the paper if properly used.

I think a more useful set of instruments would consist of a 5½-inch compass for pen and pencil, a 3-inch compass for pen and pencil, 5-inch hair-spring dividers, two 5-inch drawing pens a set of three spring bows 2½ inches long for pen, pencil and dividing, a case for spare needles and leads, and an adjusting key.

In Fig. 2 a fine adjustment for the needle is shown. The needle has a rack cut on the back which engages with a spiral on the face of the nurled wheel *W*. The plate *P* carries the wheel and also acts as a spring and holds the needle firmly. Another neat thing shown in Fig. 3 is the method of holding the pencil. Fig. 4 shows the old way.

The above improvements have been brought out by Messrs. Kern, of Switzerland, and are exceedingly neat.

Manchester, Eng. J. H. HUNTLEY.

The Hog in the Shop.

We often read about the end seat hog, but we seldom read of the hog in the shop. The latter has for some reason or other escaped the newspaper notoriety which the former has achieved. That the hog in the shop exists, however, we all know; in fact, I have seen so much of him, and have worked alongside of him so long, that I have long since ceased to look upon him as anything else but an incurable evil.

Numerous are the incidents that I could relate of the doings of this individual. I have lately come across some of his doings and the results thereof in the machine room of a local factory.

The factory referred to has a local reputation of being the fairest in town. Up to six months ago it had been the custom to give the men in the machine room five minutes to wash up. The reason for putting a stop to this was on account of the actions of a certain few who persisted in washing up three or four minutes before the given time.

Another system that prevailed at this factory was to give the men on election day one hour to vote, with pay. At the recent election the self-same individuals again showed their colors. Instead of taking an hour, they took anywhere from an hour and ten minutes to an hour and a half. Two of them (to use the words of the new apprentice) came in "half shot." The next day the following notice was tacked up:

"On and after this date all hands in this department must vote on their own time."

"Per order —— —— ——."

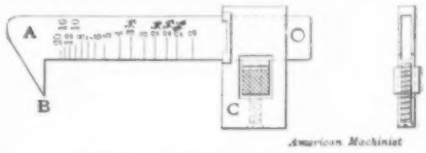
While the stand taken by the company in making the majority suffer on account of the actions of a certain few is to be criticised, the fact nevertheless remains that the hog in the shop exists, as does his friend of end seat fame.

C. F. EMERSON.

Depth of Gear Tooth Gage.

I herewith send you a sketch and particulars of a depth of gear-tooth gage I made some time ago.

It consists of piece *A* which is 1-32 sheet cast steel, with a tempered scratch point



DEPTH OF GEAR TOOTH GAGE.

B and graduated with the following pitches: 2, 2¼, 2½, 2¾, 3, 3½, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 16, 18, 20. The graduations for pitches, 9, 11, 14 and 18, are not shown in the sketch, as these are marked on the other side.

The part *C* is made of a piece of ⅛x7-16 inch cast steel which is tempered to prevent wear. It has a slot thru it that fits the graduated end of piece *A*, and by means of a small nurled nut and screw can be clamped at any desired pitch. A small steel shoe is provided just above the clamping nut to prevent the latter from burring the edge of *A*.

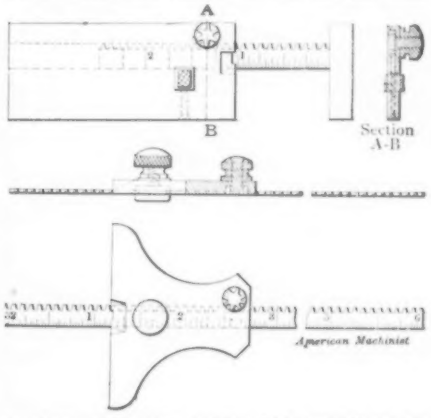
This tool takes the place of nineteenth pitch gages made in the usual way, and answers practical purposes equally as well.

E. J. TOWNDROW.

Chelmsford, Essex, England.

Caliper Rule and Depth Gage With Rack and Pinion Adjustment.

The sketches show two standard tools made by Brown & Sharpe, and to which I have added racks and pinions for adjusting when setting to any fixed size. The racks were cut 20 teeth to the inch in both cases; the pinion in the caliper rule has 12 teeth and the pinion in the depth gage 14 teeth. The pinions were made, as shown, with a small shank to fit a nurled head, and the two parts were riveted together after being placed in position.



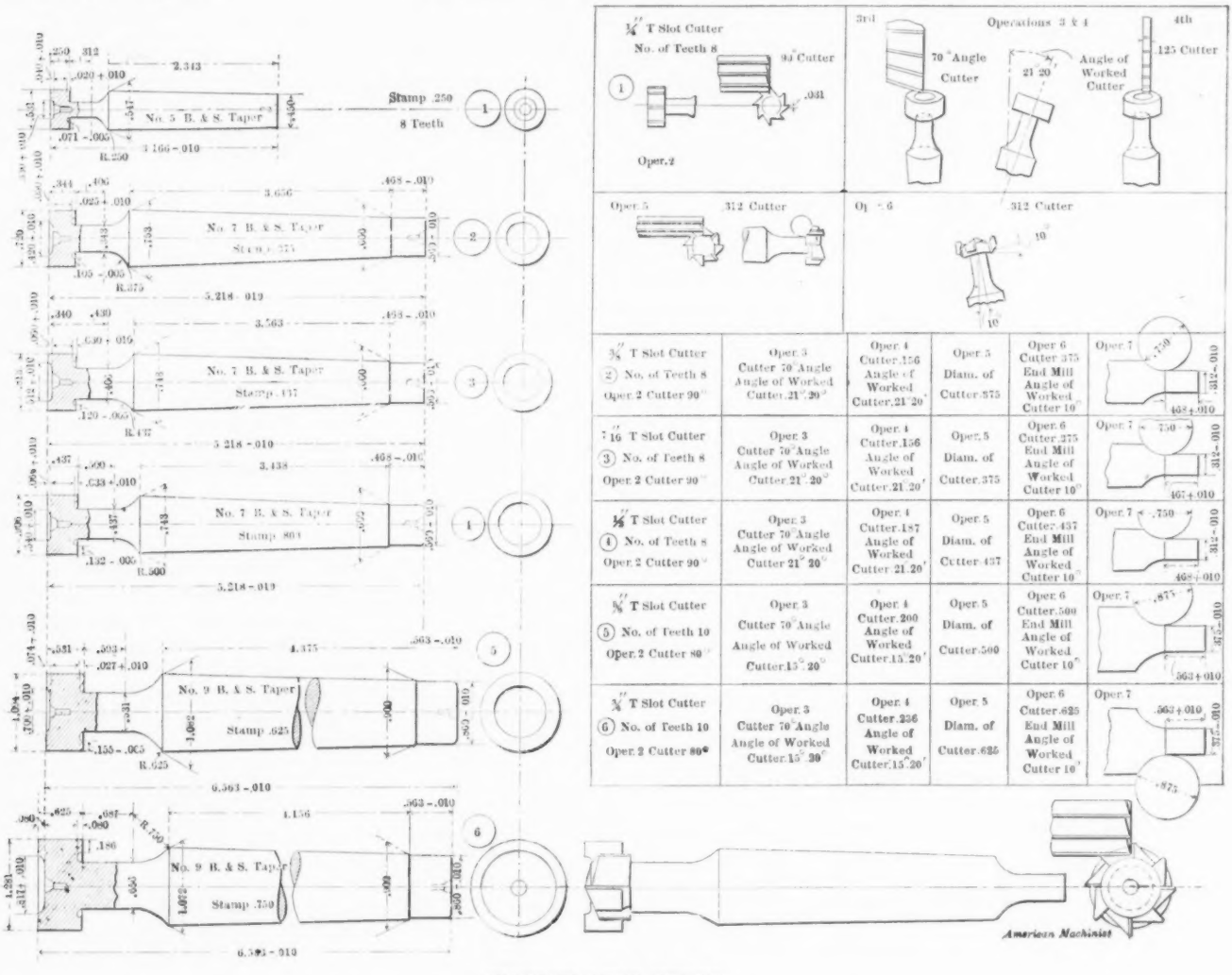
CALIPER RULE AND DEPTH GAGE WITH RACK AND PINION ADJUSTMENT.

E. J. TOWNDROW.

Chelmsford, Essex, England.

Making T-Slot Cutters.

This class of cutter has gradually and successfully outclassed the old style method of the planing T slots in milling machine tables and other machinery where T slots are regularly used. It has not only outclassed the planer and shaper in speed, but in the quality of the work done. With this in view, I have outlined a series of operations and tools to assist those who may have this tool to make. As will be seen from the drawings, the cutter is made completely by machining ready for hardening. Where many are to be made, this ensures uniformity throughout.


Stamp .250
8 Teeth
No. 5 B. & S. Taper
No. 7 B. & S. Taper
Stamp .437
No. 7 B. & S. Taper
Stamp .563
No. 9 B. & S. Taper
Stamp .625
No. 9 B. & S. Taper
Stamp .750
1/4" T Slot Cutter
No. of Teeth 8
90° Cutter
Oper. 2
70° Angle Cutter
21° 20'
Angle of Worked Cutter
125 Cutter
Oper. 5
312 Cutter
Oper. 6
312 Cutter
10°
3/8" T Slot Cutter
(2) No. of Teeth 8
Oper. 2 Cutter 90°
Oper. 3 Cutter 70° Angle Angle of Worked Cutter 21° 20'
Oper. 4 Cutter .156 Angle of Worked Cutter 21° 20'
Oper. 5 Diam. of Cutter .375
Oper. 6 Cutter .375 End Mill Angle of Worked Cutter 10°
Oper. 7
5/16" T Slot Cutter
(3) No. of Teeth 8
Oper. 2 Cutter 90°
Oper. 3 Cutter 70° Angle Angle of Worked Cutter 21° 20'
Oper. 4 Cutter .156 Angle of Worked Cutter 21° 20'
Oper. 5 Diam. of Cutter .375
Oper. 6 Cutter .375 End Mill Angle of Worked Cutter 10°
Oper. 7
1/2" T Slot Cutter
(4) No. of Teeth 8
Oper. 2 Cutter 90°
Oper. 3 Cutter 70° Angle Angle of Worked Cutter 21° 20'
Oper. 4 Cutter .187 Angle of Worked Cutter 21° 20'
Oper. 5 Diam. of Cutter .437
Oper. 6 Cutter .437 End Mill Angle of Worked Cutter 10°
Oper. 7
5/8" T Slot Cutter
(5) No. of Teeth 10
Oper. 2 Cutter 80°
Oper. 3 Cutter 70° Angle Angle of Worked Cutter 15° 20'
Oper. 4 Cutter .200 Angle of Worked Cutter 15° 20'
Oper. 5 Diam. of Cutter .500
Oper. 6 Cutter .500 End Mill Angle of Worked Cutter 10°
Oper. 7
3/4" T Slot Cutter
(6) No. of Teeth 10
Oper. 2 Cutter 80°
Oper. 3 Cutter 70° Angle Angle of Worked Cutter 15° 20'
Oper. 4 Cutter .236 Angle of Worked Cutter 15° 20'
Oper. 5 Diam. of Cutter .625
Oper. 6 Cutter .625 End Mill Angle of Worked Cutter 10°
Oper. 7
American Machinist

STANDARD T-SLOT CUTTERS.

In the first operation is shown the lathe work necessary. In all cases where grinding has to be done add .010; to the cutter part add .020, which is sufficient for that purpose. In the following operations we will take a ¼-inch cutter as an example. The first operation is the turning. The second operation, shown in Fig. 2, is milling the teeth on the outside; an end mill of about ⅝ inch or ¾ inch is recommended. The number of teeth given is 8; angle of cutter required, 90°. Third operation, shown in Fig. 3, is milling the teeth on the face. In this operation the worked cutter, which is the cutter being made, should be placed at an angle of 21° 20′ from the vertical line, this angle being suitable also for the fourth operation. In the third operation the working cutter required is an angle cutter of 70°; while the worked cutter is in this position we commence the fourth operation, which is gashing every other tooth. It is essential that clearance for chips should be considered in these cutters; the cutter required in this operation being an ordinary ⅛-inch slotting cutter. In operation No. 5 a similar gashing of the teeth takes place, only on the back instead of the front, the worked cutter being held in a horizontal position, the working cutter being a 5/16-inch end mill.

Operation No. 6 is the backing-off of the teeth at the back. The same working cutter can be used as in operation No. 5, the worked cutter being held in a vertical position at an angle of 10°.

In the ¼-inch cutter no tongue is necessary. As will be seen in the tables, all cutters above this size are made with a tongue on the end of the shank; operation No. 7 gives the end mill required, and sizes of the tongues. At the bottom of the series of operations is shown a complete cutter.

England. J. LORD.

Carborundum for Dressing Emery Wheels.

Some three years ago I by accident stumbled on to a new use for carborundum. Being engaged in the mechanical line and using emery wheels of various sizes, which had to be trued and shaped quite often, I found myself one day with an unruly emery wheel and no device for dressing it such as a star dresser or diamond point. So the idea struck me of trying an old discarded carborundum wheel. I tried the experiment and to my surprise the result was remarkable. This old carborundum wheel did all of our dressing thereafter to our perfect satisfaction. The carborundum does not become heated while dressing and leaves a beautiful finish when thru doing the work required. Where I am at present employed we had a $20 diamond, and one day it jumped out of its holder and we were up against it again, for we wanted to shape some wheels on a Brown & Sharpe grinder. So I suggested we send and get a stick of carborundum 1 inch diameter by 4 inches long, and it did the work beautifully. As it only cost 35 cents per stick, it has entirely replaced our diamond point and saved further expense.

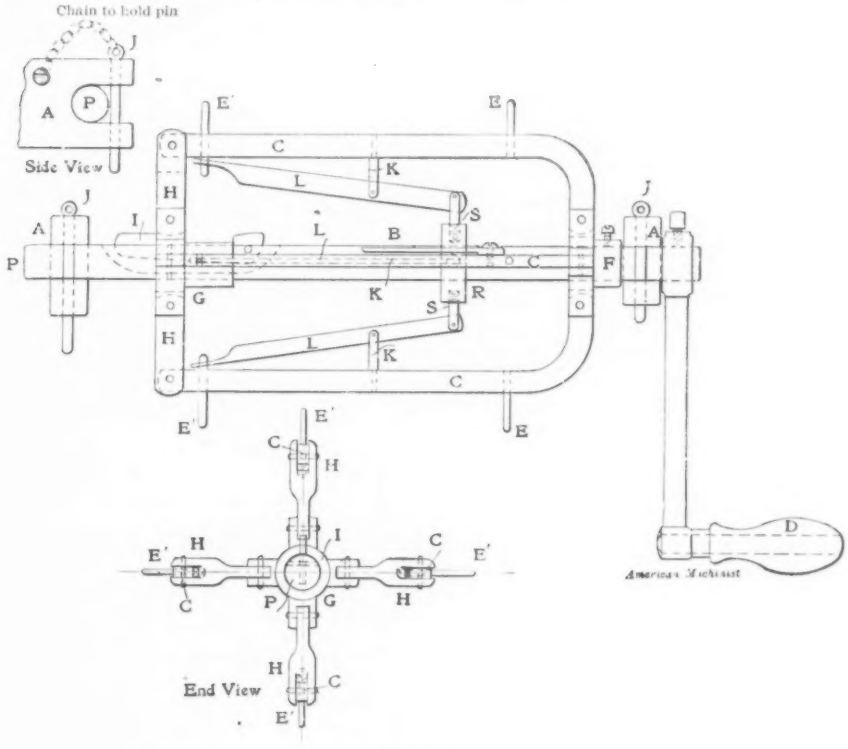
I think that the manufacturers of carborundum would make coarse-grain sticks for the trade if they only knew what a fine emery-wheel dresser they had. Now, Mr. Editor, this is a shop kink which is worth while, and I think manufacturers will be glad to know, as it does perfect work, is cheap and will last indefinitely.

Please do not think that I am writing an "ad" for carborundum; it's only a compliment to the inventor of carborundum.

CLAUDE R. PITROT.

A Scrap Winder.

The illustration shows a scrap winder used on a large press which forms twelve shells at each stroke. The brass roll from which the shells were punched was about 7 or 8 inches wide, and being difficult to handle on the ordinary form of winder the one shown was designed. A boy had to stand by this press all the time while in operation. The winder was held by two arms *A A* which extend from the body of the press. As the scrap comes thru, the boy slips the end under *B* which is screwed on the arm *C*. Then by turning the handle *D* the roll is wound on the arms *C C C C*, being guided by the pins *E E'*. *F* is a collar with four-slotted shoulders in which arms *C* are held by pins. *G* is another collar of the same form, in which are the four swinging links *H*, also held by pins. In the joints *H* are held the other end of the arms *C*. The collar *G* has a small key-seats in which the key *I* fits. The key *I* is held on one end by a small pin and on the other end by a spring underneath (not shown). Now, when the roll is all wound the boy slips out the pins *J* from the arms *A*. Then taking the winder out he presses on the key *I* (which is held up by a spring) until it comes flush with the surface, then collar *G* slips out over it. It can be seen from the description that as *G* slips out, *H H H H* swing in and draw the arms *C C C C* together. As the arms *C* go down the pins *K* press the arms *L* down, which in turn draw down the pins *E'*. The pins *E'* have eye-holes in which the points of the arms work. When the pins *E'* are drawn down flush, the boy gives the winder a shake and the roll drops into the scrap barrel. The end view does not give an exact detailed view, but it gives enough to show the main principles. *P* is the shaft on which the whole rig is held. The collar *R* is held on the shaft *P* by a set-screw and holds the pins *S* in which arms *L* move. This is a lightly constructed rig and can be used to good advantage on work of this kind.

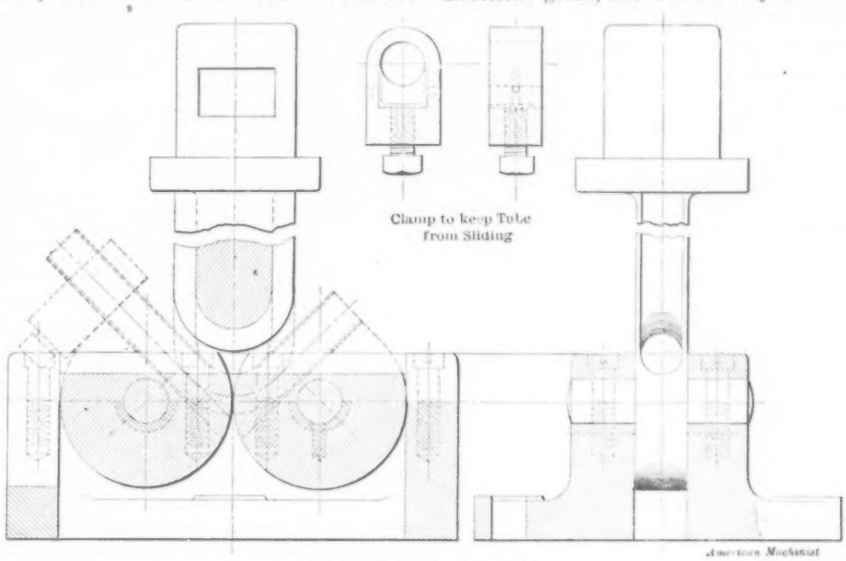


A SCRAP WINDER.

PEDRO RE.

Press Bending of Tubes.

Having asked your paper to publish something about bending tubes, about a year ago, and having read a few months later the information elicited, I tried the directions given, but found a way whereby I could get quicker and better results, especially so for use in manufacturing processes where time and uniformity are so necessary.



PRESS BENDING OF TUBES.

I enclose a sketch of a punch and die for bending tubes at any angle up to 180 degrees, the angle being determined by the setting of the press. The tubes are filled with lead and are laid on the die, which consists of the two rolls, which give the tube a positive bearing all around at any point of the bend.

The sketch shows in dotted lines a tube partially bent, with the punch partially raised to give a clear view. If the punch continues to go down thru the rolls the tube is bent to 180 degrees when the center of the punch is in line with the centers of the rolls.

The small clamp on the tube is used to keep the tube in position or to keep it from slipping, as the tube, in being bent, pulls against the punch in one direction and against the clamp in the other. The clamp also locates the tube so that it will be bent in the right place.

R. T. BELL.

The Practical and the Technical Man.

I have read with interest your articles on the practical and the technical man, and would like to write a few words in explanation to the letter of the discontented engineer at page 1618, Vol. 27. In regard to this particular case, my opinion is that the writer in question has been in contact with the younger school graduates rather than with those seasoned by experience. The average college man when

he comes out of school has done little toward specializing, and his knowledge of manufacturing and its processes is therefore small. I believe that the main complaint brought by the practical man against the theoretical is that he is not a specialist immediately after graduation. The student, however, "must creep before he can walk," and the inconsiderate criticisms hurled at him for blunders and bulls made during the early period of his career are nearly always undeserved and unjust. For could the faculty of the college know just what branch a man intends to enter, their task would be lightened and they would be able to send each man out into the world well fitted in his chosen line. This, however, is impossible. The school endeavors to give to each of its members a broad engineering education which tends to fill him with the ambition to grasp all knowledge to be obtained by contact with any concern he may associate himself with. The function of the scientific institution, moreover, is not one of warfare with those men who have fought their way to the front, and some of whom have never seen the inside of a technical school, but one of co-operation, in which the theory of the former combines with the practise of the latter to uplift engineering in all its branches. W. T. M.

Turning Cross-head Shoes and Eccentric Straps.

Fig. 1 shows a very neat scheme for turning crosshead shoes for bored slides. The method is available in any engine shop doing small or medium-sized work (in quantity), and can be adapted to taper gibs as well as to the kind shown. It must be perfectly apparent to any machinist that it is far better than the usual "cutting wind" process. The chuck for the shoes is of course accurately made and the shoes and the engine slides must be always true to dimensions.

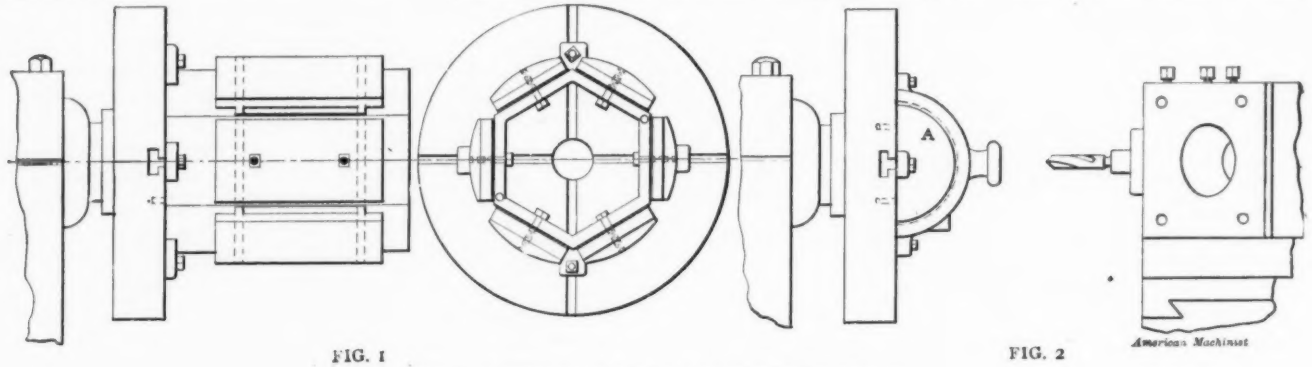


FIG. 1 FIG. 2

TURNING CROSSHEAD SHOES AND ECCENTRIC STRAPS.

Fig. 2 shows how they used to finish eccentric rod straps in the same shops. The straps are bolted to a semi-circular block *A* correctly located on, and doweled to, the face-plate of a Bullard turret lathe. In the ordinary shop this job is often done on a drill and time is lost in changing tools, and the fitter after that has his own troubles in "pointing" the rods. By the method shown the drilling, facing and tapping are done in rapid succession, and the rods point right without fitting.

F. WERTHEIM.

Making Thin Soft-Solder Strips — A Lathe Mandrel.

A short time ago we required some solder strips about 7-16 inch wide by .011 thick; the thinnest we could buy was 1-16 inch thick. Brad first tried hammering it, but this was too slow and made it difficult to handle. He tried one or two other methods before he finally went down to the storeroom and fished out an old roll feed which he bolted on to an iron stand. This was brought over to the back of a lathe. The top roll had a shaft sticking out; taking one of the change gears of the lathe, he made a bushing for it so that it would fit on this shaft. He then brought the table around so that the gear would engage a gear on the lathe and then bolted the table to the floor (see Fig. 1). Starting the lathe up, gear *A* turned gear *B* of the roll feed, which started the two little gears on the other side, and these kept the rolls going at the same speed. Placing the strip at the mouth of the rolls, it was drawn thru. By adjusting the rolls tighter each time the strips were all passed thru, they were soon brought to size.

Fig. 2 is an arbor for turning the large plate *P*. These plates (12 inches diameter) were first rough turned on the face-plate. We tried finishing them on the ordinary arbor, but when the tool came out as far as *X* there was too much chatter and spring, and when finished they were not accurate enough. So the foreman had this cheap but effective arbor made. Casting *A* is a part of a clutch bored a driving fit for *B*, and held by taper pin *C*. *D* is a gray-iron washer and holds the plate to be turned, it being tightened by means of the nut *J*. After *A* was driven on *B*, a light cut was taken over the lugs *E* to true them. The plates are finished in this manner: They are first rough turned on the face-plate. Then they are placed on the

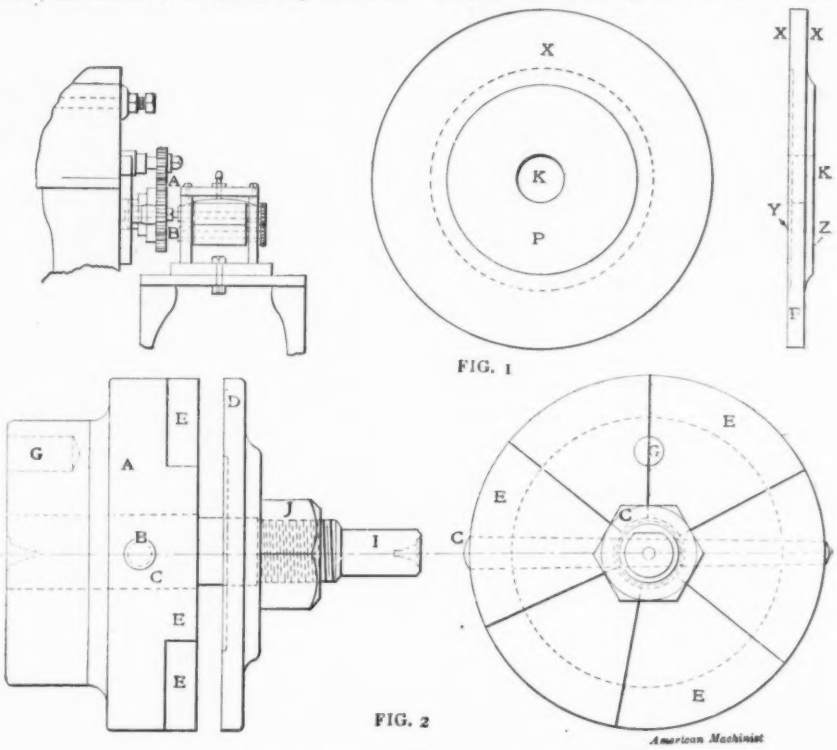


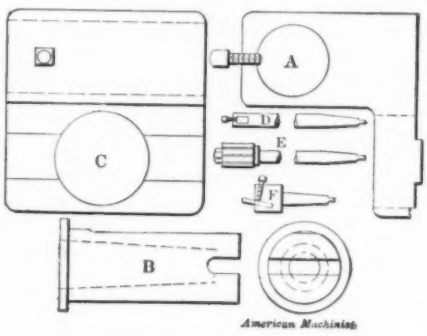
FIG. 1 FIG. 2

MAKING THIN SOLDER STRIPS. A LATHE MANDREL.

ordinary arbor and a light cut taken over the recess *Y* and the shoulder *Z;* this brings these faces true with the hole *K*. Then when they are all finished in this manner they are placed on the heavy arbor, the recess *Y* fitting on lugs *E* and the plate *D* clamping on the shoulder *Z*. Then finishing cuts are taken over sides *X*. In this manner the sides come smooth and the same thickness all around, besides being true with the hole *K*. For driving the arbor a pin is placed in the hole *G* and passes thru the face-plate. The thickness between sides *X X* varies from 5-16 to 3/8 inch. The front view of the arbor is shown without plate *D*. PEDRO RE.

A Drill and Reamer Holder.

This is a holder to be used on a lathe for drills, reamers, boring-bars, etc. The hole *C* passes over the tool-post and an



A DRILL AND REAMER HOLDER.

ordinary turning tool will serve as a clamp. The hole *A* is put thru while the holder is clamped in position by holding the drills and reamer in an ordinary lathe chuck; this brings the hole to the right hight. The bushing *B* is made of steel and should be a good fit in the hole *A*. It is held in position by a set-screw which tightens on the flat. The bushing has a No. 4 Morse taper hole, into which the taper shanks of the reamer *E* and boring bar *D* fit. Any drill which has a shank less than No. 4 Morse taper can be held by using collets.

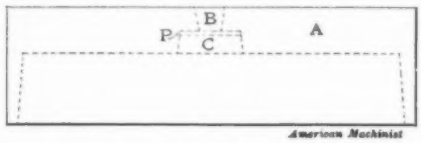
To get reamers and drills central with the hole to be chucked, the cutting edge can be got central in the usual way, and the holder then set so that the tail center of the lathe will coincide with the centers of the taper shanks. The power feed of the carriage can be used for most jobs, and for others the tail center feed will do.

The value of the holder will show itself in chucking duplicate work, as when it is once set your tools can be quickly changed without disturbing the holder. If needful, a tool for facing off the piece to be chucked could be made like *F*.

It is designed more to be used in the toolroom than in the main shop, as it, of course, could not compete with the modern turret lathes. Of course it can only be used on the lathe for which it was made, unless you have two lathes of exactly the same size. OWEN.

Finishing Holes in Gray-Iron Castings With a Punch.

Several years ago I invented a little device, of which the gray-iron box shown in the illustration was a part. The device itself was a commercial failure, but the



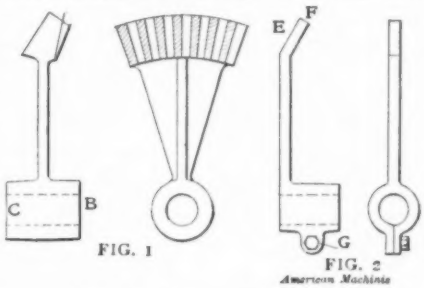
PUNCHING HOLES IN GRAY IRON.

method of producing the hole *B C* I think worth describing. In the first few pieces this hole was drilled thru the size of *B*, and then counterbored at *C*. This method proved too costly. A pattern was made with the holes in it, and with the draft toward *C*, leaving a stepped green-sand core (*B* was about 1/4 inch diameter by 1/4 inch long). This did not draw very well and many bad castings resulted. More draft in the holes would have worked all right, but it was advisable to have the end of hole *B* next to *C* smaller, if anything, than it was at the other end. I then made a pattern with the taper for the holes from opposite sides, the small ends of the holes being in the center of the castings, as shown in the illustration. A dividing plate *P*, of brass about 1-64 inch thick, was then soldered in the bottom of hole *C*. This was molded with *C* in the drag and *B* in the cope. The molders had no trouble, the castings came out perfect, and all that was necessary to finish the hole was a tap with a center punch to knock the thin film of iron at *P* out. The counterbore *C* was a loose fit for the head of a machine screw and *B* for the body. The punch was used from side *C* so as to keep the corners from breaking away.

DIXIE.

Jig for Fixing the Relation of Teeth to Hubs in Cast Segments.

Some time ago we had a number of gray-iron quadrants to bore and face like those illustrated at Fig. 1, having cast



THE SEGMENT AND THE JIG.

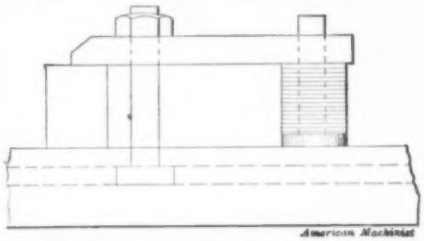
teeth at an angle of about 103 degrees. It was essential that the faces *B* and *C* be in proper relation to the teeth.

As it was quite a tedious and unsatisfactory process to lay off each part so as to get the hole square and also the proper distance from the pitch line, a jig like the illustration Fig. 2 was made and fastened to the tailstock spindle by the tap bolt *G*.

The face *E* of the jig was made at the angle of pitch + face of tooth, also extremity *F* was the exact distance of outside diameter of the quadrant. All that was necessary was to place the quadrant in chuck, run the tail spindle up to the casting and set it by the jig. The result was all that could be desired, and this simple device saved much time, money and annoyance. ALPHEUS.

Extensible Planer Clamp Block.

The sketch shows a new kink that I call the "lightning change planer clamp block." In addition to the regular bolt hole in the clamps there is a second hole in the rear end, a little larger than the diameter of the post. I use posts 1 inch diameter, 2½ inches at the base, from 4 to 12 inches in length, varying by 2 inches. With a set of these posts, which can be made cheaply on the turret machine, and a box of 1-inch punched washers, there need be no delay looking for odds and ends that will often



EXTENSIBLE PLANER CLAMP BLOCK.

roll the work and themselves out of position when pressure is put upon the clamp.

J. J. NEWBAKER.

Difficulties in Negotiating for Employment.

When a concern wishes to employ a man in any responsible position, and it becomes necessary to advertise for one, the advertisement will read something like this: "Wanted—A thorough, practical, up-to-date man of large experience, capable of handling a large number of men, and able to keep costs down to a minimum. Give references and salary. Address X. Y. Z., Box 4-11-44, AMERICAN MACHINIST."

This item meets the eye of one who knows he possesses all the requirements, but who has had no experience in the writing of ads. and so cannot describe the goods he has to deliver in a manner that will appeal to the credulity of the advertiser, consequently his description of his abilities is consigned to the waste basket. He may be as good a man in his particular line as the country can produce, but if he writes in such a manner as to give the impression that he realizes that fact himself, he slides down the incline again. If too modest the same result follows. A company may advertise its product as the "best in the world" and laud it to the skies as unexcelled by any other production of the kind, but the man who is directly responsible for its good quality must not

extol his part in the production, as it would be brag, blow, "hot air," or what-not.

Then the matter of references comes up. A good man will work for a concern for several years and render good, faithful and effective service, but with some member of the firm employing him there may exist an incompatibility of temperament. After several years of endurance the man resigns and tries for a position elsewhere, but fails to get a good recommendation from his past employer. Again he may send copies of references, but the company he sends them to may treat him as a forger and immediately write to the company issuing the recommendations to verify the statements contained in them, thus making extra labor to the writers of those recommendations.

them was of only six months' duration. Nearly all of the preceding men were fully competent to fill the position and many of them are to-day satisfying other employers.

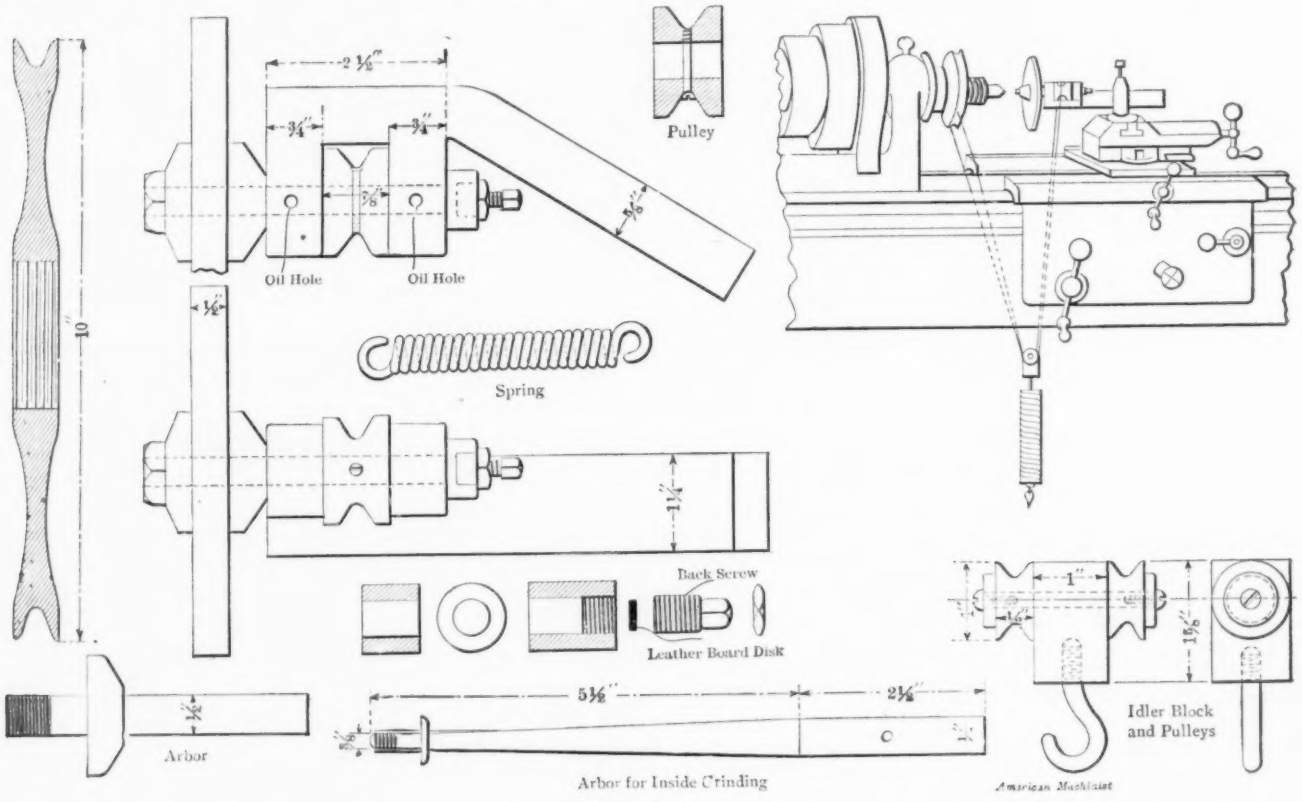
This is but one of the many instances where the seeker after a position gets taken in. Had I asked and required of the company references as to its character, etc., from the prior superintendents, and had such a demand been complied with, I would never have accepted the position.

The system of securing positions by references as now in vogue is a misuse of power, as were once the irresponsible acts of kings. Non-conformity to your employers' ideas, demands, business policies honest or dishonest, right or wrong, disagreement on the subject of politics, resentment of insult, and many other little things

Handy Lathe Grinder.

The lathe grinder here shown is used in the Boston & Maine Railroad shops here for grinding centers, reamers, mandrels, locomotive rod pins and bushings, and for a great variety of small tools. It can be used on any lathe and is easily and quickly set.

The tool body is of gray iron bored for ⅞-inch brass bushings, which are pressed in. The arbor is of tool steel fitted nicely to the bushings. On the arbor is fitted a grooved pulley which is fastened to the arbor by a 6-32 flat-head machine screw which goes thru the arbor and is threaded into the opposite side of the pulley. End play is taken up by the back screw and check-nut. The same pulley fits the long spindle for inside grinding. The idler



Why not have some such method for determining the ability of an applicant for a position as the government has in its civil service arrangement? That would eliminate some of the difficulties, but there would still remain a very serious one: it provides for only one side of the negotiation. A firm advertising for a man is not required to furnish references, but assumes a position which imputes all justice, honor and righteousness to itself when such a position is often unwarranted.

A few years ago I applied for a position with a large concern in Massachusetts. My references, etc., were satisfactory and I was engaged. Subsequently I learned that this concern had had thirteen different men in eight years, twelve of them in five years. Suffice it to say that my stay with

enable him by the power conferred by the reference system, not indeed to rob the offender of life, but to blast his future and impair that of his family. Why should business men take the position that all employers are always right in their estimate of a man? How many are broad-minded enough to recognize and acknowledge merit even in the face of personal feeling or prejudice?

If such things are true, and it is impossible to deny their truth, ought there not to be some way devised whereby an honest man can place himself in connection with an honest firm, without the necessity of submitting his fate and future to the peculiar whims and personal feelings of a nervous, physical and mental dyspeptic?

A. W. S.

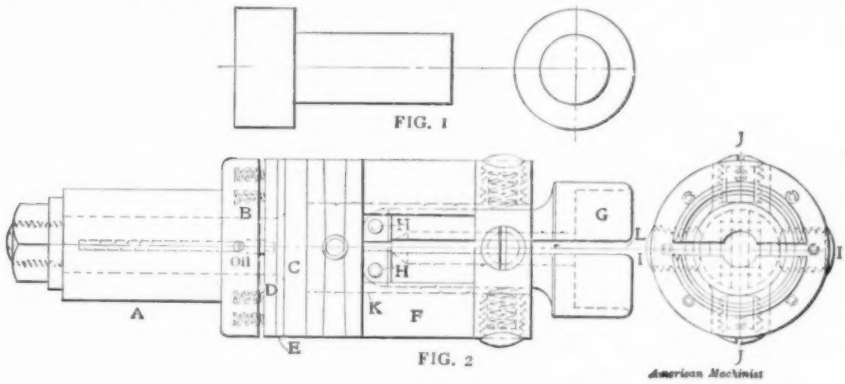
block is a piece of soft steel shaped to 1x1x1⅝ inches. It is drilled for a 5-16 inch drill rod which goes thru, extending out on each side ⅝ inch to receive the pulleys. The ends of the rod are drilled and tapped for 10—24 machine screws which hold a washer against each pulley. The grinder is run by a ¼-inch round belt going over the pulley on the lathe spindle, then to the idler block, to the tool-post, back to the idler and lathe spindle. The belt is kept at proper tension by the pull spring which is fastened to the floor by an eye screw. This spring is made of 3-16 inch rod, is 1¼ inches in diameter and 12 inches long. Tho the speed of the wheel, 5 inches in diameter, is rather slow, it gives good satisfaction and more of these grinders are being made.

JOHN H. CRAIGIE.

Concord, N. H.

A Transfer for the Magazine Automatic.

When the automatic turret lathe is equipped with a magazine feed it is necessary that there be a fixture in the turret to transfer the piece of work from the magazine to the chuck. The casting shown in Fig. 1 is what we are handling on our automatics, the small end being gripped in the chuck while working it. The machines will each turn off two hundred pieces per day, so that the transfer has to stand for some hard usage. The magazine on these machines is directly over the chuck. When the operations on the casting are finished, the chuck opens and the knock-out rod ejects the piece. At the bottom of the magazine and directly over the chuck is the holder, which receives one casting at a time. As the casting is knocked out of the chuck the holder drops in front of the latter, the transfer in the turret comes forward and seizes the casting, the holder rises, the transfer moves forward, puts the piece in the chuck, the chuck tightens and the transfer withdraws. The whole operation, beginning when the finished



TRANSFER FOR THE MAGAZINE AUTOMATIC.

casting is knocked from the chuck and another one placed there, occupies about five seconds' time, so if anything catches there is very likely to be something doing. The casting is supported in the holder at two points on the bottom, and variation in the size of the casting will cause it to tip so it will not present itself squarely to the transfer, and very likely may cause a smash-up. Now, these castings vary a sixteenth of an inch, besides not being round, so a transfer has to be pretty rugged to stand up.

The first ones we had came with the machines and were made from a solid piece of steel bored out to fit the head of the casting with a shoulder to keep it from pushing back, the depth of the hole being about 2 inches, and the other end fitting the holder *A* in Fig. 2. This transfer was sawed in five places to enable it to spring, and tempered. It would work all right until a casting dropped wrong and then either it would break or bend all out of shape; on an average it would last about a month.

Fig. 2 shows a transfer which we made and which has been a complete success. We are not the originators, but it is a sort of a redesign of many different styles seen in other parts of the shop. The holder *A* fits the hole in the turret and is made of soft steel; the springs *B* take care of any variation in the length of the casting. *C* is the shank made from tool steel and an easy running fit in the holder *A*. *D* is a steel washer case-hardened and containing two pins which slide freely in holes in the holder and prevent the washer from turning. *E* is a fiber washer between shank *C* and washer *D* to prevent abrasion *F* is the body of soft steel forced on to the shank and held there by four taper pins. *G G* are the jaws—tool steel and hardened on the end. The jaws swing on the pins *H* and are held from moving sideways by the screws *I*, which are adjusted so as to allow the jaws to move up and down easily, yet with no play. The space between the jaws is ⅛ inch and they are held from coming together by tits ⅛ inch diameter turned on the ends of the screws *I*. The screws *J* are hollow and hold the springs, which are made from 1-16 inch wire, are 5-16 inch outside diameter and are tempered very stiff. At the time I made this transfer I had a lathe and a shaper to do my tool work on; no dividing attachment for either, and all drilling was done in the lathe, so making this transfer called for some careful laying out. I assembled the transfer all except the jaws and then I foresaw trouble. The jaws of course were made in one piece and cut in two after being finished. I took the piece for the jaws, the slot on the end of which I had made a light driving fit on the tongue *K* on which the jaws would hinge when finished, and drove it on, then placed holder *A* in the vise and revolved the body in it and trued up the piece for the jaws, until it ran dead true, by tapping lightly with a hammer. When I had got it to run true I drilled the holes *H* and put in the pins. Now the question was, how to cut slot *L* so that it would be in line with the tits on screws *I*. I solved it in this way: I made a screw fitting the holes for screws *I* and carefully trued it up in the chuck and put a ⅛-inch hole thru it, taking great pains to get it true, then counterbored the hole so that the scratch awl would enter, leaving only a thin rim with the ⅛-inch hole thru. I then put the screw in place of one of the screws *I* and after testing to see if the piece for the jaws ran true, I scribed a ⅛-inch circle on the piece thru the hole in the screw. Then replacing screw *I* and repeating the operation on the other side. I had the position marked plainly on the piece where the screws would come. It was a simple matter then to line up in the shaper and cut the piece in two with a ⅛-inch tool. When all parts were assembled the jaws ran so that there was no wink to the eye and that was considered good enough.

PAUL WESLEY

Planing Machine Drive.

Your correspondent, "Veteran," at page 1179, Vol. 27, brings up a question or two about planing machine drives. He mentions a worm and worm wheel in connection with a friction clutch. A similar drive, as far as the worm and worm wheel go, has been put for years by a Halifax firm, which however, went out of business this year, on a machine which I think is a very good one. It has a cross-planing motion on the crossrail for machining the ends of castings, a drilling head, which would drill a hole anywhere within the capacity of the machine, and an extra housing bolted to the side of the bed for side planing, etc. I judge it to be nearly twenty years since this machine was designed, and yet I believe it agrees perfectly with the latest practise in the States, in that it performs as many operations as possible on large pieces without the necessity of resetting the work.

To return to the friction clutches; these have been made and used for years to my knowledge, but, as far as I can remember, only on screw planers (tho I should think they would be just as applicable to rack-driven machines). The clutches no doubt save a great deal of the wear and tear of belts, and I should say they would be more efficient in operation than the usual belt-shifting gear.

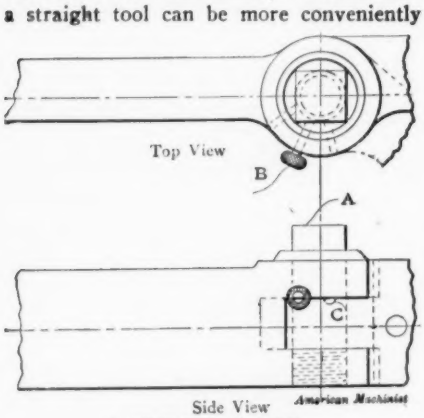
"Veteran" asks why buffers are not used at each end of the stroke to absorb the momentum of the table. This is done in England by a Leeds firm, the Bateman Planing Machine Company, which advertises its machines to return at 200 feet per minute. This is accomplished by an arrangement of spring buffers and I think, from what I have heard of this machine, that a very smooth motion is given to the table, the reversals being made without shock or jar. Smith & Coventry, of Manchester, also have an arrangement for this purpose. I have not studied this arrangement very closely, but think it is a kind of a spring clutch, which at each reversal, when the shock is greatest, slips a little, thus taking the jar off the gearing. The question now is: Do the spring buffers, etc., answer the purpose for which they are used? I don't think they do, at least not fully. In the case of a planer platen running, say, at 30 feet per minute, the

circumference of the driving pulleys will run at anything from 1,800 to 4,500 feet per minute, and the momentum of the pulleys at this speed will be considerably greater than the momentum of the table. Therefore if a buffer be applied to the table, it follows that when the machine reverses, the pressure in all the gears will be on the wrong side of the teeth, so that before the belt begins to operate on the table it will have to take the backlash or lost motion out of all the gearing. This is done with a great amount of hammering on the wheel teeth. I think that a better arrangement would be to have a brake on the pulley shaft, so that at the moment both driving belts were on the loose pulleys, the machine is nearly brought to a stop by the brake. The pressure on the teeth would then be in the right direction for the return stroke and a smoother action would be attainable. Of course this is only a rough idea and would need working out. It would perhaps be rather awkward to get the machine to move the belts after it had been practically stopped by a brake. It would need something to store up energy (similar to a spring) to move the belt-shifter after the machine had been stopped by the brake. YOUNGSTER.

Keighley, England.

A New Style Tool Holder.

The sketch herewith presented shows a new idea for a thread tool-holder. The end for holding the cutter is the Pratt & Whitney style, but the new idea is in the joint which enables the holder to be easily converted from a straight to an offset position, as indicated by the dotted lines in top view. The advantage of this is obvious to most machinists, for sometimes a straight tool can be more conveniently



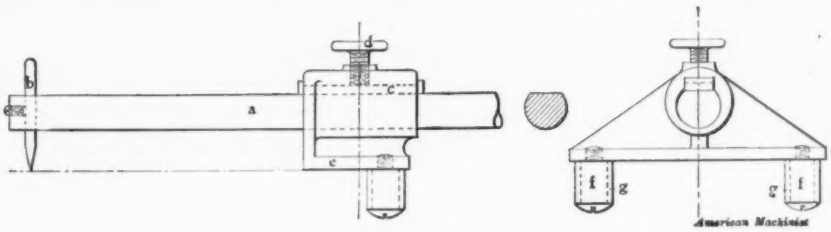
A NEW TOOL-HOLDER.

used than an offset, and *vice versa;* hence this holder does away with the necessity of two solid ones.

To convert the holder from straight to offset, it is only necessary to let up on the screw *A*, withdraw the pin *B*, swing forward end around until the half hole *C* is in position to receive the pin *B* again, replace the pin *B*, tighten down on the screw *A*, and there you are with an offset of about 35 degrees. This idea can also be applied to the Armstrong type of tool-holder. R. B. BOONE.

A Scratch Gage.

The sketch enclosed, of a scratch gage, shows a useful addition to a kit of tools. The bar *a* is ⅜-inch round steel, ground up true, flatted on the top side, and drilled ⅛ inch diameter at one end to take the scriber point *b* which is held fast by a small screw. The sliding head is a light casting with a ⅜-inch hole reamed out to slide on the bar *a*, and a key *c* fitted in for the screw *d* to press against. The face *e* is machined, and two holes are drilled and tapped to fit the pins *f f* which carry the hardened steel rollers *g g*. These



A SCRATCH GAGE.

allow the head to slide freely. I have found it exceedingly handy in laying out pitch circles of bolt holes on large cylinder covers, and for a variety of other work.

S——, England. J. WHEELER.

An Experiment With a Draftsman.

In Mr. Osborne's very interesting letters heretofore he has told us how a shop should be conducted, from the apprentice boy to the manager, and at page 1461, Vol. 27, he gives us a few hints on the drafting end of the proposition. The shop of which he writes had, apparently, never before employed a draftsman, and when they got one he did not prove to be the genius they expected. This sort of a sly kick at the draftsman recalls to me an incident which happened in the Pittsburg district.

Blank's shop had been running full for several months, and the foreman was getting tired of trying to make drawings and oversee the shop at the same time, so it was decided to engage a draftsman.

The business required a man to give his whole time to this part of the work, and then a real, simon-pure draftsman at once places the real small shop on a plane with the large manufacturing plants.

Accordingly, a blind advertisement was inserted in the local newspapers for a first-class mechanical draftsman. By the time all the answers had been looked over, Mr. Blank had decided that draftsmen were very expensive luxuries. Jones seemed to be a good man, who had worked almost everywhere for the past fifteen years, but $150 per month was entirely beyond reason. Brown appeared to be a better man than Jones, but his $90 per month was a shade more than Blank cared to pay.

Hans Schnitt, M. E., a graduate of two European high schools and one university, with six weeks' practical experience in Europe, desired a personal interview; salary, $50 per.

A European trained engineer for $50 per month, and a common draftsman asking $150 seemed like robbery on the part of the common draftsman.

A small storeroom in a corner of the machine shop was cleaned up. Hans was granted the much desired interview, and this resulted in his engagement. He had been in this country only a month at this time, and still carried his M. E. with him; for it takes several years of hard knocks to teach a foreign draftsman that a degree doesn't mean very much in the United States, unless accompanied by many years' professional practise.

His first work was very light, being simply to measure some machines already erected in the shop, and make detail drawings of parts. With this work he got thru fairly well, excepting a metric dimension here and there, and occasionally, where he had to make reductions from decimals to common fractions, he used a table of decimals of a foot instead of decimals of an inch.

An order was received for a plate shear about three months after Hans' appearance. As the specifications called for a shear differing in some respects from Blank's standard, it was decided to design an entirely new machine.

The new pattern work was done by outsiders, for Blank seemed to think all he needed in that line was a man to keep patterns in repair—that is, a hatchet-and-saw carpenter. This machine was on a rush order, as usual, and every detail as soon as finished was hurried to the patternmakers, from there it went directly to the foundry, and exactly twelve days from receipt of the order the greater part of the castings were in the machine shop.

Mr. Blank and the foreman thought it would be impossible for an engineer to make any mistakes on such a small job, so it jarred Mr. Foreman somewhat to find a bushing bored 4 inches diameter for a 5 inches diameter shaft; this prompted him to look over the drawings. What he saw in these made his hair stand on end, for altho they were nicely drawn, no two pieces would fit one to the other, except a clutch bracket and housing and this bracket was sticking right thru the arms of a large, healthy gear wheel. Hans didn't want this machine to run without doing work from the start, so he arranged it that the upper knife would shear about ⅜ inch off the lower knife the first stroke. It was specified that the shear would make 30 strokes per minute, but by his ratio of gearing it would have made about 70

strokes. The motor might have been in the operator's way, so it was placed 5 feet to one side of the machine, with no visible means of support. This motor episode led some waggish successor of Hans' to write on the tracing, "Sky hooks to be furnished by the purchaser."

After an earnest discussion of the matter between the two, Hans, at the urgent request of Mr. Blank, handed in his resignation to take effect at once.

Everybody in any way connected with the shop made caustic remarks about Hans and draftsmen in general. Mr. Blank was very bitter in his denunciations, but his loss was quite heavy and nobody blamed him very much.

He had quite a number of good men to choose from, but his cupidity led him to select a cheap man—the variety that is dear at any price—thinking he was a poor foreigner that did not know his own value. Hans had to choose between this job and starvation, probably, owing to his being new to the customs of this country.

His slight experience had been gained in a large engineering office, where every line he made was criticised by a chief draftsman, and he naturally expected this at Blank's. Learning he was to get no assistance, he waded in and tried to make the best of a bad bargain at $50 per month, with very poor results for a mechanical engineer.

It was a case of both biters being bitten, and I wonder if Mr. Osborne wasn't bitten by this same hoax: a good man at a poor man's salary. C. A. C.

Some Makeshift Tools for Boring, Counterboring and Making Washers.

Fig. 1 shows how a counterbore was made with a piece of cold-rolled stock, a lathe dog, and a piece of self-hardening steel such as is used with the Armstrong tools. *A* is a piece of cold-rolled iron of suitable size, *B* is a piece of self-hardening steel which can be ground to suitable size. For light cutting one dog is sufficient; for heavy cutting I use two dogs to prevent slipping of cutter. This tool can only be used on plain work.

In Fig. 2 a tool is shown which consists of a straight-tail dog with a slot half thru to line at *E* and cut all the way thru the rest of the tail; this slot can be from 3-16 to ¼ inch wide. The cutters should fit snugly; they are adjustable. *D* is an ordinary 1-inch washer used as a clamp. *A* is like in Fig. 1 a cold-rolled piece of suitable size. This tool was made in a jobbing shop where experimental work is done; it was used for cutting out washers of sheet iron and brass, facing, counterboring, and sometimes boring. I show only two cutters. A greater variety of work has been done with these tools than was first intended; for instance, the cutter *C* is for turning the hubs on a little job that could not be done on the lathe.

Fig. 3 is a tool made for cutting wood disks out of a board. A ¼-inch reamer hole was drilled in the tail end and reamed with a worn ¼-inch reamer which gave just the desired fit for a piece of drill rod used as a cutter. It is better to drill the hole a little nearer the center, as in that case a piece of sheet iron can be laid in the bottom of the dog to get the right distance, the holes being ¾ inch, the outside varying from 3 to 7 inches. The cutting

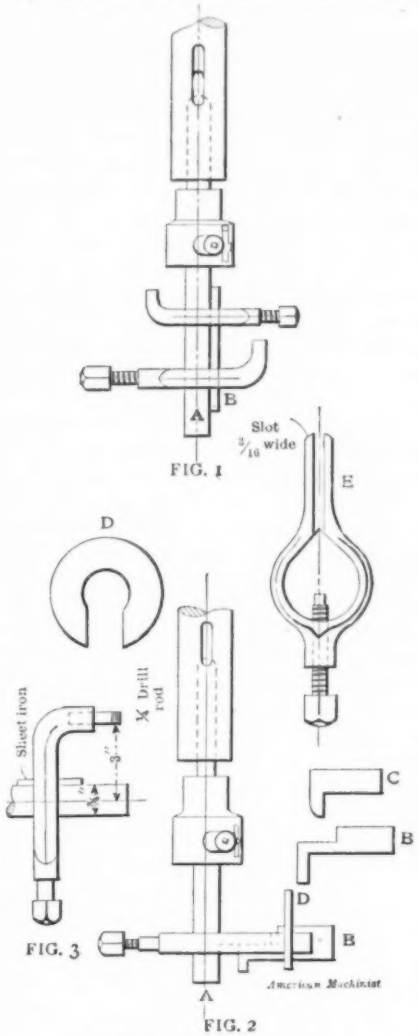


FIG. 1

FIG. 3

FIG. 2

SOME MAKESHIFT TOOLS.

was done about half way on one side and then from the other side.

I may mention that each of these tools was used in different shops, conditions and work being of a different character.

D. WINKEL.

Setting the Four Boring Cutters.

I have had an experience with a boring head like that of Mr. De Leeuw in boring the fuse holes of large gray-iron projectiles. Figs. 1 and 2 are both entirely wrong. It would be impossible for all four cutters to cut at the same time or do the same amount of work. **Fig. 3 will make** each of the cutters do an equal share of the work, but it is very rarely used, owing to the rough and irregular holes it bores, due to chatter. Fig. 4 is very nearly correct. Its cutters must be set in depth just so that the circle made by each cutter will be different, the first must cut the deepest (traversing the smallest circle), the second not so deep, the third less, and the fourth still less. This has proven to give the best results in handling a large lot of projectiles, a true and smooth hole. Fig. 4 shows all four cutters arranged well except that the first cutter is set too deep in relation to the last. M. V. B. BENTZ.

At page 1474, Vol. 27, A. L. De Leeuw shows four heads with the cutters set in different positions, and his question is, "How should the tools be placed so as to make each of them do an equal share of the work?" Well may Mr. De Leeuw say that he has his own opinion and is afraid he will stick to it.

In the case of Fig. 1, where the tools are set in the same plane but set to dif- the work?" Well may Mr. De Leeuw say puts this style of head out of meeting the requirements when he says, "The diameters to which the different tools bore increase by equal amounts," as obviously the longest tool will remove more metal than the short one on account of the larger diameter.

In Fig. 2, while the tools are all set to the same diameter but not in the same plane, the tool that is ahead will do most if not all of the work. For proof of this, notice the one heavy chip turned out by a twist drill with one long lip, as against two equal chips when the two lips of the drill are ground to the same length; also notice how the chips pile up in front of the long tooth of a gear cutter, a butt or hollow mill. It is the long lip on the drill and the long tooth on a cutter or mill which gets dull and needs grinding the most.

The head shown in Fig. 4, where the tools are not in the same plane and also bore to different diameters, as in Fig. 1, will leave the long tool to do more work than the short one on account of the greater diameter of the hole. This will leave the head shown by Fig. 3 to be the only one shown where each tool will do an equal share of the work.

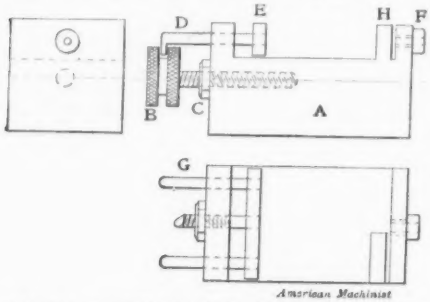
By setting the tools in Fig. 1 and Fig. 4 so that the tools would remove an equal amount of metal—and this would call for an unequal increase of diameter bored by each—it is probable that either Fig. 1 or Fig. 4 would be better than Fig. 3, and if the change was made I should favor the style of Fig. 4, as in that style the cutters that follow would have no chance at all to scrape the surface of the one ahead where it lapped. G. SCHNEIDER.

[The question of Mr. De Leeuw seems to have been not much of a puzzle after all, as replies have come in with practical unanimity in favor of No. 3. The letter of Mr. Bentz here printed seems to indicate a somewhat exceptional experience. His statement that No. 3 is seldom used is to us a rather surprising and doubtful statement. Letters upon this subject

which it is not necessary to print, as they cover substantially the same ground, have been received from M. H. Westbrook, M. H. Ball, Geo. L. Hause, Chris. Christensen, Geo. Haley and "Roderick Dhu."—Ed.]

Rig for Cutting Small Rods in the Milling Machine.

I send herewith a drawing of a metal cutting device which I used and found a good rig for cutting metal rods to length. The device is made of machine and tool steel only. The body *A* is a piece of machine steel 2x2x3½ inches long. *B* is a nurled screw for setting the gage *E*. *C*



RIG FOR CUTTING SMALL RODS IN THE MILLING MACHINE.

is a lock-nut for locking it. *D* is a piece of round stock the end flattened and bent, and works in the groove of the screw. *E* is the gage made of tool steel, hardened. *F* is a steel bushing. *G* are guide pins for the gage. *H* is a slot for a circular saw.

The manner of using this device is to remove the screw feed from the miller and use a lever. The lever is pushed back and forth. The work is fed as fast as the machine will cut. This was designed to save time over cutting in the screw machine; there is a saving of about 500 per cent. by this method.

L. I. ROSENTHAL.

Difficulty of Making Really Accurate Taps.

There are several things about taps that should be kept within the proper limits of accuracy, but, judging from what one hears from users, we are led to believe that the diameter is the only point watched. My experience with taps is that variations of lead or pitch cause more trouble than variations of diameter. There is no special mechanical difficulty in making taps (when soft) a constant diameter and lead of threads, and the angles can also be as ordered. Trouble comes in the hardening operations. Take a lot of taps of any diameter and length of thread and measure them after hardening. You will find a much greater variation in their lengths than you will in their diameters. The only true way that is known to me to determine the diameter and lead of a tap after hardening is to tap out a nut with the tap, then fit a screw to the nut. Be sure not to have more than two to three threads in length on the screw, and for the reason that if the screw is as long as the nut and both are not exactly of the same lead, we will have to cut the screw smaller than the nut in order to have it pass thru. Then after fitting the short threaded screw mentioned, measure it with the special micrometer made for measuring diameters of screw threads and you have the diameter of your tap.

Screws with angular threads should always be measured on the sides of the threads and not on their outside diameter. A slight variation on the outside diameter causes no trouble in fits, as no angle thread fits top and bottom. After finding the diameter of a tap, you will have to compare your figures with recognized standards of threads. There is but one standard to compare with, and this is the United States standard, or what is sometimes known as the Franklin Institute. There is no standard for what is known as the V-thread. Each maker of taps and screws seems to have a standard of his own.

As to testing the lead of the tap, tap out a nut as long as convenient—1 inch if possible—then cut it in halves and measure the number of threads. This can be done only with a special measuring machine or caliper. This method may seem expensive to some of your readers. However, as I said, I know of no other. When measuring the threads on a tap for lead, be sure and measure each flute or land, as you will find the leads vary very much in the different flutes. Therefore my recommendation in tapping out the nut. The old saying is, "The proof of the pudding is in the eating," so the proof of the tap is found in what it will do. Carbon steel taps will, in hardening, increase in diameter and shrink in length, and it will be found that this increase and shrinkage will not be uniform. I have known of some good toolmakers to consider that 1-32 inch in 12 inches was a standard shrinkage. My experience leads me to the conclusion that the allowance made for shrinkage in taps must be based on the diameter relative to the length; that is to say, in the case of a small diameter and a long thread, the shrinkage per foot will not be the same as for a large diameter and short thread. There are other causes for variation in diameter and length, such as steel coming from the mill varying much in its parts and working; then the annealing and hardening if not done uniformly will cause trouble. High-speed steel will be found much different from carbon steel. Instead of its diameter increasing, it decreases in diameter and length, but only a very small amount. If taps are made with a hole in the center and of high-speed steel, the hole will be found to increase in diameter. If of carbon steel, it will decrease. The only method I can think of to overcome the variation from standard diameter and lead is to grind to size after hardening. However, I know of no commercial way to grind out the variation, and for the present it seems that we must content ourselves with the variations that come to us in hardening.

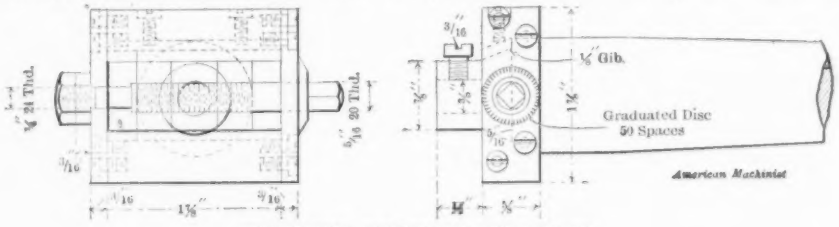
Of all the trouble I know about in the mechanical line, this question of fits between screws and nuts is the most vexing, and it is little understood in most of the shops. I have known of a man writing to all of the screw makers in this country for a set of screws V-shape thread, and to be carefully selected as to size. The reply in each case was, "Whose taps do you wish the screws to follow?" If this order was for the United States standard thread the makers of screws would know what to send. Space will not allow me to refer to the screws and nuts found in the market at the present time. Their variation is ten times greater than that found in the taps, and I assure you that taps vary more than we would like. Therefore what a mix-up we have. It would be interesting if some of your readers would give us their experiences.

TAP MAKER.

A Boring Tool Holder for the Miller.

The tool shown in the accompanying sketch has been found indispensable for boring in the milling machine. The old method of adjusting the cutter by tapping with a hammer, or whatever comes handy, is slow and uncertain to say the least. This tool is not only much quicker of adjustment, but it does away with the uncertainty entirely. While jig bushing holes do not as a rule have to be standard, it frequently happens that holes have to be bored to gage in the milling machine. That operation the writer has usually found to be difficult and sometimes impossible to perform perfectly by the old method. With this tool it becomes so easy and simple that a novice can do good work the first trial. The shank and squared part are made from one piece of mild steel, except the end pieces, as shown. The boring tool can be removed and a drill substituted for starting a hole. The tool is inexpensive, and will be found to be a gilt-edged investment.

TOOLMAKER.



BORING TOOL HOLDER FOR THE MILLER.

Revival of American Machine Exports to Germany.

Consul-General Mason, of Berlin, Germany, transmits an interesting report on the above-mentioned subject, as follows:

For several obvious reasons, which have been cited from time to time in these reports, the exports of American machinery and machine tools, which reached their highest development in 1899-1900, declined in 1902 to about one-third of their greatest volume. The causes of this falling off were mainly three: The general prostration of manufacturing industries in Germany at that time; the fact that German machine shops equipped with American machinery had learned to duplicate most of such machines and many other articles at less than the cost of the imported originals, and that many American manufacturers had established branch factories in Germany, the products of which competed directly with the output of the parent manufactories in the United States.

It is now apparent that the period of lowest depression is definitely past, and that, notwithstanding all adverse influences, the export of American machinery to Germany is increasing in due proportion to the general recovery of industrial activity in this country. The measure of this renaissance of a once flourishing and important trade will be apparent from the following comparison of the total imports of certain classes of American machinery during the first nine months of the years 1903 and 1904:

Kind of machinery.	1903.	1904.
	Metric tons.	*Metric tons.*
Sewing machines	1,570	2 339
Machine tools	724	1,634
Metal-cutting and boring machines	91	206
Pumps	109	142
Typewriters	90	114
Electrical machines	27	63

IMPORTS OF CERTAIN CLASSES OF AMERICAN MACHINERY INTO GERMANY, FIRST NINE MONTHS OF 1903 AND 1904.

Two reasons are ascribed for this rather unexpected increase in the machine imports which compete most directly with home-made products, namely, the conviction which prevails in many quarters that the original machine, made in the country where it was invented, is superior to any copy or reproduction of alien origin, and, secondly, the fact that since the demands of the American home market have relaxed, with the diminished activity of the past fifteen months, our manufacturers and exporters have given more attention and effort to their foreign trade.

It is just this point in the present revival that is worthy of being recorded and its significance recognized. In an old and highly developed country like Germany, where not only the wants of its people in manufactured merchandise are fully covered by home-made products but a large surplus of most goods is produced for export, the importation of similar wares from foreign countries must depend largely upon the intelligence and energy with which trade is pushed by the exporter and his agents in German markets. It is a settled belief in Europe that Americans, altho unsurpassed as manufacturers and caterers to their own countrymen, have only an incidental interest in foreign trade, and that this interest, such as it is, fluctuates in close and direct relation to the condition and demands of the home market. During the highly prosperous period of 1902-3 in the United States the export of many articles to Europe languished because manufacturers at home were too busy to attend to orders and correspondence from abroad. Complaints were frequently brought to consulates that American exporting firms would not even answer inquiries as to prices and conditions of delivery. It was at this time that the financial correspondent of the *London Times*, being sent to make an exhaustive study of the growing "danger" in the United States, encouraged his readers with the assurance that—

"The truth is that foreign trade in any systematic way is now beyond the knowledge of the American people. I was almost tempted to say that it is beyond their desires and intentions. That in an indefinite way they would like to have a foreign trade is perhaps true; but for the reason that they have been so long accustomed to look to the home market, it is impossible for them to take the steps that would give them any considerable share in foreign markets. After all, Americans are the most conservative people in the world so far as outside conditions are concerned, and so where these are involved they are content to go on doing a foreign trade that is merely complementary to the home trade. If Count Goluchowski and some of the German, Russian, and French dreamers could only know the real truth about this people they would have little reason to concern themselves with their new bogey, the 'American danger.'!"

This is of course an extreme and therefore misleading statement of the case. The fact is a great many, perhaps a majority, of American manufacturers and merchants are indifferent to export trade, and as a consequence careless and ignorant concerning the methods by which it should be developed and maintained. They regard foreign markets only as a convenient outlet for their surplus products in time of overproduction resulting from dullness and depression in the home demand. Notwithstanding all that has been said and written, they go on sending catalogs and circulars in English with values in dollars, weights in avoirdupois, measurements in feet and inches. They insist rigidly on American terms "Cash against B. of L." and kindly inclose a United States stamped envelope for the reply of the expected customer.

But, on the other hand, there are a large number of American manufacturers and exporters who really know that they want export trade, and have taken up the work, of establishing, developing, and maintaining it, with all the energy, skill and adroit adaptation of means to ends which distinguishes them as manufacturers and caterers to their home trade. They have come to Germany and established agencies either with German firms of high standing or as branch offices under their own management; their skilled salesmen have traveled over the Empire with samples and price lists printed in German units and currency, and their goods are known here for just what they are, no more nor less. It may fairly be assumed that when the manufacturers and merchants of the United States definitely make up their minds that they want a broadly developed, progressive, and permanent foreign trade, they will go about the work of obtaining it as ably and successfully as they have mastered the resources and capabilities of their own country.

It is because American pumps, machinery, typewriters, shoes, and many other manufactured articles are well known and appreciated here that the demand for them has recovered and kept pace with the general revival of prosperity in this country. The greatly increased importations of the past nine months are evidence of a vitality in the German market that will repay any intelligent, well considered and directed effort. No European people buy more readily and liberally what they want, none are more free from narrow prejudice against merchandise of foreign origin, none are more keenly interested in every novelty and valuable improvement, than the Germans. If the field here is less ready and easily worked than it was ten years ago, it is only because German manufacturers now supply cheaply and in unsurpassed quality many of the goods which were then imported, but there are still lucrative markets in the Fatherland for those who will seek them discerningly and cultivate them with intelligent and persistent energy.

Article.	Value.
Sewing machines	$8 6 836
Tools	240,322
Metal-working machinery	886,785
Pumps	73 271
Typewriters	857 989
Electrical Machinery	75,682

VALUE OF EXPORTS OF AMERICAN MACHINERY INTO GERMANY IN THE YEAR ENDING JUNE 30, 1904 (FROM DATA OF BUREAU OF STATISTICS, DEPARTMENT OF COMMERCE AND LABOR).

Under the Australian patent law, the provisional protection fee is £1 ($5); on lodging complete specifications, no fee; when the official examination results in a decision to "accept" the fee is £2 ($10), and about four months later the final fee, prior to issue of patent deed, is £5 ($25). When we remember that altho Australia has an area equal to that of the United States its population is only about that of New York city, these fees are certainly high enough.

Melting With the Air Furnace.

BY DR. R. MOLDENKE.

Of late there has been manifested a noticeable tendency toward securing castings of a higher grade for machinery purposes. Founders have tried to rise to the occasion by adding large proportions of steel scrap to their ordinary mixtures, with more, and often less, success; but the fact remains that the cupola process for melting, tho the cheapest, damages the metal by reason of its contact with the fuel. Sulfur is absorbed in proportion to the amount present in the coke and to the ignorance of the melter regarding the chemistry of his process.

For rolls, guns, special dies, and all high-class articles where gray iron is preferable to steel but must have exceedingly good characteristics, the air furnace has been the rule for a long time. Many foundries are thus equipped and turn out a metal which approaches the 40,000-pound limit.

The chief difference between cupola and air furnace practise is that in the former the metal is in contact with the fuel while melting, while in the latter it is only touched by the flame. Carrying this still one step further, by using the open-hearth furnace, with its comparatively higher temperature, we save the time necessary to bring the furnace up to heat after charging. As a consequence the metal remains a much shorter time exposed to oxidizing influences, and a gain of about 2,000 pounds per square inch in strength results. The open hearth furnace, however, is an expensive furnace to build and maintain, and is only really economical when used practically continuously. In the foundry its use is restricted to modern malleable iron works where the daily tonnage comes near the fifty mark or above it.

Wherever a company is satisfied to pay about half a cent a pound more for its castings, provided very considerable improvement results therefrom, the air furnace is the thing to use. This furnace, which dates from the middle of the eighteenth century, is necessarily an oxidizing or refining furnace, and the more perfect the regulation of the air supply, the quicker the process acts. Silicon, manganese and carbon are burned out, leaving the iron relatively stronger, provided too much oxidation does not take place in the iron itself during the process. I have seen a coal with about 3 per cent. sulfur used in the air furnace, and enough sulfur has been imparted from the flame to the iron to raise the percentage of this deleterious element in the castings from 0.04 to 0.22. Hence the advisability of selecting good fuels for the work.

From the nature of the case, no iron can be tapped from the air furnace until the whole charge has been melted, this process differing therein from that of the cupola. Moreover, after the charge is melted, the metal must be overheated up to the desired casting temperature. The pouring of the molds must therefore be done within a comparatively short space of time and at the right time, as to let the overheated metal remain in the furnace is injurious.

While an air furnace of three tons capacity can be built, it is better to take at least a six-ton construction and make half charges in it if this must be. Most of our foundries have air furnaces of some twenty to thirty-five tons capacity, the

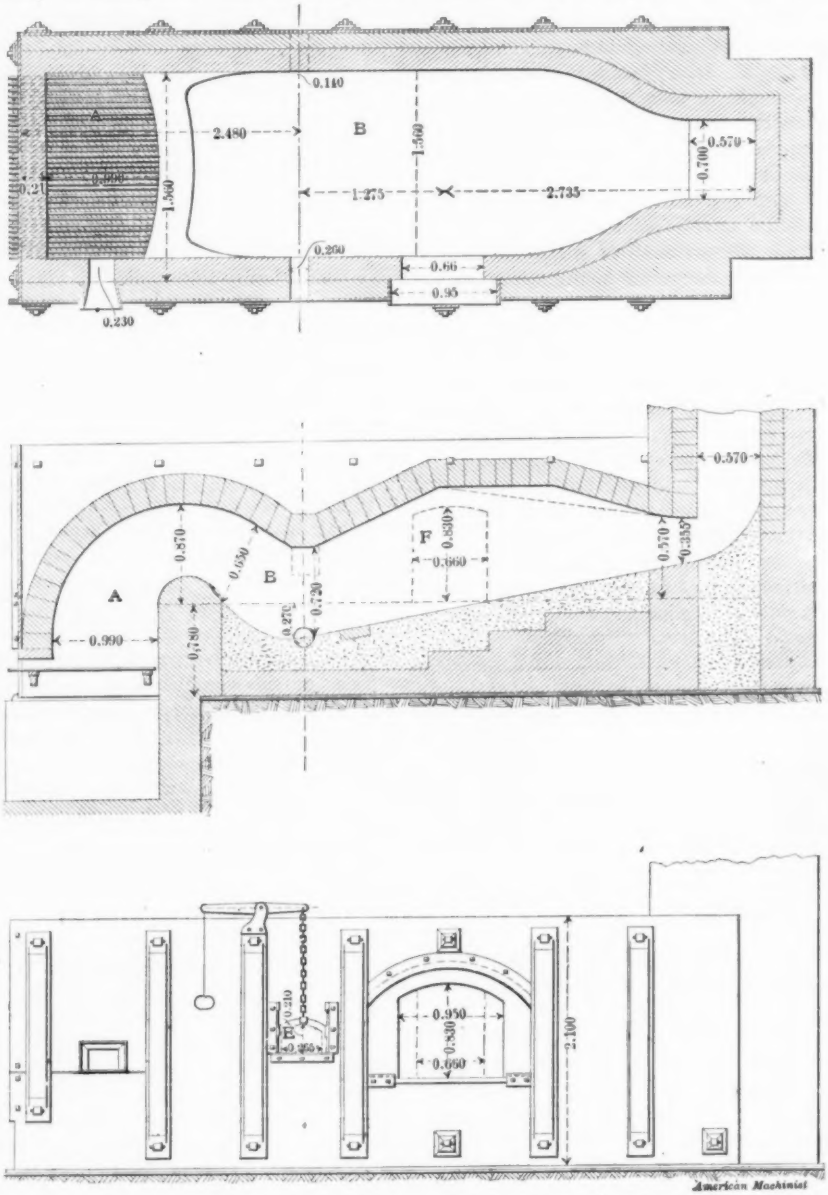


FIG. 1. FIVE-TON EUROPEAN AIR FURNACE AFTER LEDEBUR. (METRIC DIMENSIONS.)

This is an air furnace after Professor Ledebur, the dimensions being given in the metric system. This example is shown, as it illustrates the functions of the air furnace very plainly, our American practise differing only in the details of construction.

The hearth is inclined, as shown, and the charge being placed on the upper portion, the melted metal runs down and collects next the bridge wall. This allows the flame to play upon the stock continuously until all is melted. The serious disadvantage of this construction is that once the charge has been entirely melted the feather edge of metal at the end of the bath is under the strongly oxidizing influences of the flame and is usually badly burned. To remedy this the hearth should be so constructed that between the upper end of it and the stack connection a step is left such that when the charge is fully melted at least three or four inches of metal may remain there. The deteriora-

malleable works confining themselves to the smaller sizes on account of the shorter time required to tap and pour with them.

A TYPICAL EUROPEAN AIR FURNACE.

European practise has confined itself to the typical hearth furnace of old, a fire-box at one end, the inclined hearth in the middle and separated from the fire-box by the bridge wall. The stack is at the other end of the hearth. The roof is sloped to allow the flame to play on the hearth and the charge thereon, as shown in Fig. 1.

ting influences of the gases will thus be somewhat counteracted, if not done away with entirely. Tho this seems so easy a solution of the difficulties brought about by burned iron, I have rarely seen hearths arranged thus either here or abroad. The idea is simply to give the hearth of the air furnace the shape it has in the Siemens-Martin furnace, tho with the more pronounced inclination of the former, the tap hole being left close to the bridge wall if desired. A further very serious objection is the sharp corner left at the junction of the prolongation of the hearth with the stack. This is certain to burn off from the start, and should be rounded off so that charging the next heat. In this way they save the bottom from damage and undue slagging off by iron oxide.

In order to get a proper mixing of the gases with the air to secure good combustion, it is necessary to gradually contract the cross-section of the furnace as it extends to the stack; this also would promote a greater uniformity of temperature. Some of this desirable condition is lost by the necessary raising of the roof lines at the point of charging. Here in America we lose nearly all of this advantage for our gray-iron work, as usually only a big melting chamber is provided with no special attempt to regulate the fine points of the from the hearth area. The grate bars should give admission to plenty of air. The fire bridge should be at least 20 inches above the grate.

AN AMERICAN AIR FURNACE OF RECENT DESIGN.

In our country we follow two lines of air furnace construction which are quite divergent. The malleable air furnace is built on the lines of the older construction, as shown in Fig. 1, and probably because this is really the old Staffordshire furnace brought over from England with the process. One of the latest adaptations of this air furnace is shown in Fig. 2, brought out

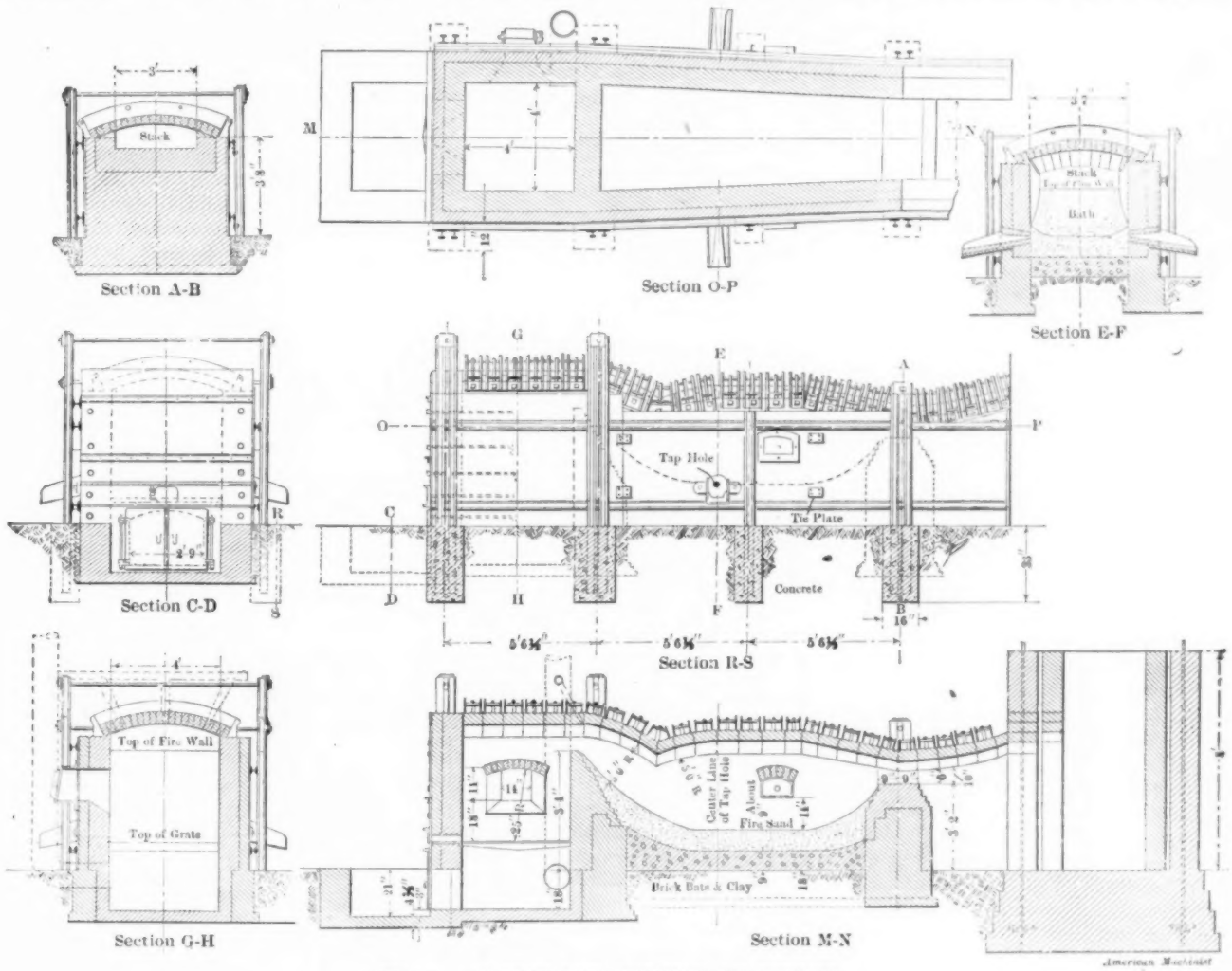


FIG. 2. AN UP-TO-DATE AMERICAN AIR FURNACE.

the flames and gases may sweep into the chimney unobstructed.

Throughout the lining of the furnace only the best of firebrick should be used. For the outer body a second quality may answer, but were better avoided even here. The bottom is made of fire sand, and is usually prepared freshly before each heat. Only in malleable practise do we find a furnace charged two and even three times before renewing the bottom, and then only when the heats follow each other the same day. While not good practise, some melters leave, say, 500 pounds of melted iron to chill on the bottom to protect this while process. The chimney may be so arranged that a base of 10 to 15 feet of brick supports an iron stack lined with 4 inches of good fire-brick.

Some of the general dimensions of air furnace parts may be given as follows: Necessarily the tonnage regulates the specific details. The grate area of the fire-box should usually be one-fourth that of the hearth area for the larger furnaces, and one-third for the smaller ones. The depth of the grate is a fixed quantity, it being arranged for comfortable firing, just as in the case of boiler grates. The width of the grate space can thus be obtained by the Whiting Foundry Equipment Company. As one passes thru the country and takes note of the various styles of malleable air furnaces designed and built by the local superintendents and foundry foremen and even melters, it is not surprising to find the melting ratio from 1 to 2 up to what it should be, 1 to 4.

These air furnaces have the roof composed of movable sections, called "bungs," which consist of arches of brick clamped together tightly by rods running thru iron shoes. This allows the furnace to be charged quickly by dropping the burden on the sand bottom. The bungs are swung

into place quickly and the furnace is ready to light up.

AIR FURNACE OF WESTINGHOUSE MACHINE COMPANY.

In gray-iron air furnace practise the necessities of the case have brought about a different construction. The melting down of heavy rolls, guns and the like, which cannot well be lowered down from above, is facilitated by removing the end wall of the furnace and sliding the charge in. The furnace is therefore built L-shaped, the end to be opened being at the lower part of the upright part of the latter, and the stack at the right-hand point of the piled up regularly at the end, sometimes even extending around the L. On firing up, the flame plays on the heavy scrap rolls and the scrap soon forms a bath which cuts the heavy material down, the full sweep of the flames meanwhile cutting right into the pig iron beyond. Oftentimes the combustion is so fierce and sustained that the flames may be seen coming out of the chimney top.

The iron now collects in the lower part of the hearth, the slag formed usually covering it pretty completely. As the iron becomes hotter it is poled thoroughly to help remove the dissolved oxides, similar to simple a construction as possible should be aimed at, and the design kept along lines furnishing a melting ratio of 1 to 4. Every regular furnace builder can do this without much difficulty. The principal aim should, however, be rather in the direction of rapid melting with the least possible oxidation, and a yield of very hot metal. It is better to have little refining action and a quick melt than a burning out of quantities of manganese, silicon and carbon in the iron, by a continued action, with dull metal at that.

For the benefit of the machinery trade it is to be hoped that the air furnace will

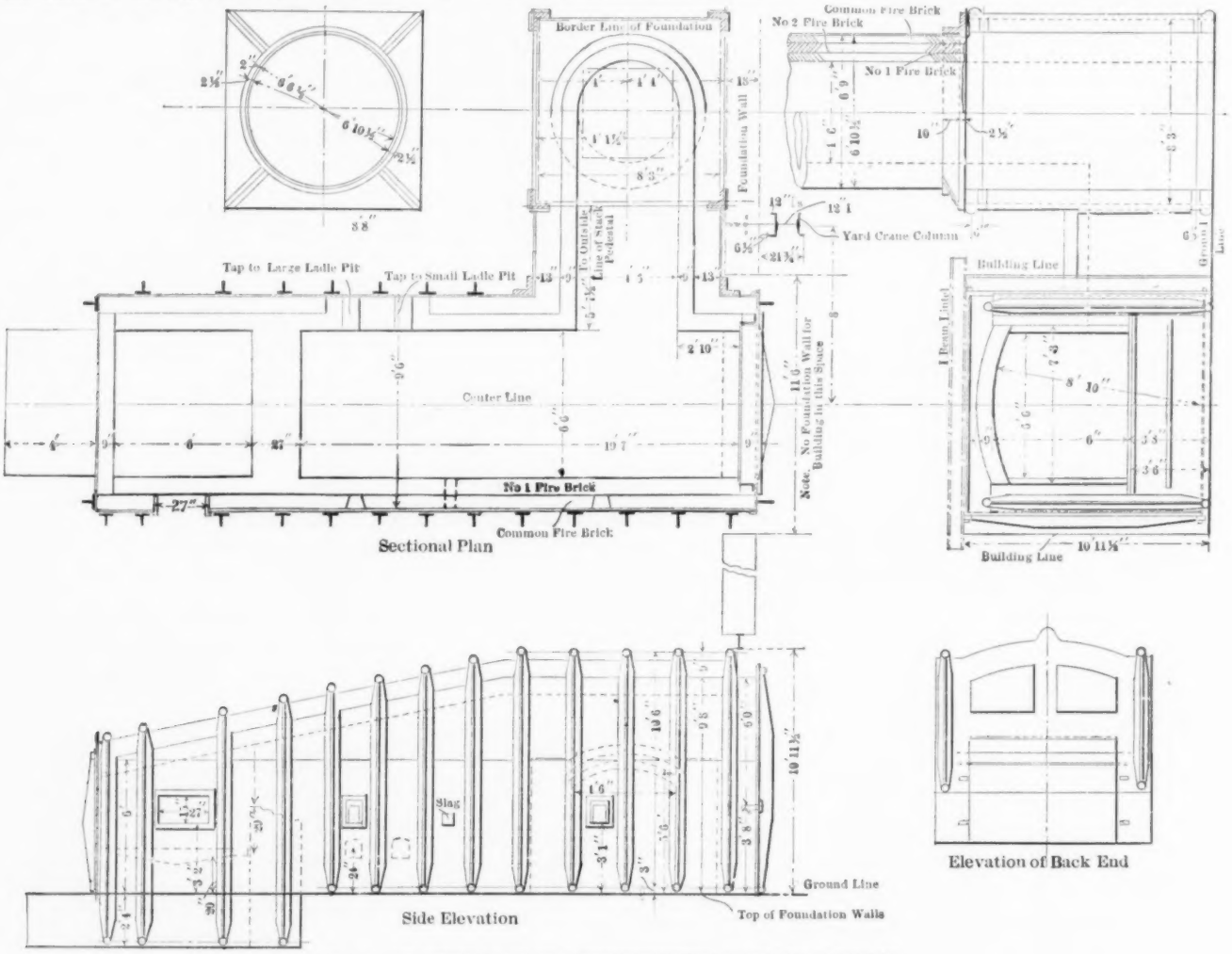


FIG. 3. AIR FURNACE OF THE WESTINGHOUSE MACHINE COMPANY.

short arm. This is shown in Fig. 3 in a typical American furnace built for the Westinghouse Machine Company. The roof slopes upward from the fire-box to allow a generous charging space, the corner of the L being turned to connect with the chimney.

The removable charging door is handled by a crane, which also places the heavy portion of the charge on the high point of the sloping hearth. This is made of fire sand, as usual, and covered with boards to prevent the charging operation from doing injury. The heaviest pieces are put in first, right against the fire bridge; next comes the small scrap. The pig iron is the refining of copper, green hickory poles being the preferable medium for this work. If the slag is too heavy and prevents the rapid penetration of heat, some is skimmed off. The tests showing that the iron is right, the charge is tapped out and cast. From the illustration it will be seen that the furnace construction is very simple, the structure being held together by buckstaves, plates, and tie rods.

Were it not an unjustifiable expense to make patterns and templets for the iron work, every foundry could readily construct its own air furnaces. As it is, it were better to have this done by outside expert help. Whatever the tonnage, as come into more general use, as nothing is more annoying than to have a casting break after much machining has been done on it. Air furnace iron promises much in the way of relief herein.

At the recent dinner of King's College Engineering Faculty at Hotel Cecil, London, Sir William White, in response to a toast, said that, including ships of the Navy which had been started by the Admiralty from his designs since his retirement, he had been responsible for something like 250 of all kinds. In fact, nobody ever made such demands on the public purse as he.

Echoes From the Oil Country—How Some Shops Grow.

Davis and Black had known each other well for some time, and now they were having one of those semi-confidential chats which are so easy to drift into with some people, and so utterly impossible with others. Davis was in the machine shop business, and had grown up from a small beginning, and was giving his friend some of his experiences and ideas as evolved during the period of growth.

Said Brown: "Don't you think, Davis, that there is a whole lot of slush written about these rich fellows who tell about how much better times they had when they were poor, and such stuff? Why don't they get rid of their money if it is such a burden?"

Davis laughed as he answered, "I guess there are lots of fellows who would be willing to take the chance of all the misery if they could have the money with it; but how about the men who are counted rich and are yet always hard up? No, I don't mean the spendthrift, but the good, careful business man. Take myself, now, for instance. I had managed to save a few hundred dollars when I started into business. I did not really want to start in for myself, but it seemed as tho I just had to to have a job. Work was scarce and that is how it came that I was out of a job, and also how it came that there was a shop for sale.

"It was either to have to spend my savings to tide me over a dull spell, or to chance losing them in trying to run a shop. Another fellow didn't want to lose what he had in the shop and so he worked hard to unload it on me, and he succeeded. It is not fiction when I say that I worked harder for myself in that shop than I had ever worked for anyone else, and I put in longer hours, too, and if the truth were told the pay for some of them was mighty small, and slow in coming at that.

"About the time that I got to know where to get work, and what was right to charge for it when I did get it, I had also figured it out that if I ever got along any I would have to have more than myself working. That meant more tools, and I hadn't paid for what I had. I was afraid of debt. Do you know, I had an idea that there were lots of people who were lying awake nights trying to think of some way of catching me if I did not just toe the scratch every time a debt was due?

"By and by I took courage and bought, and then I planned and saved and worked to keep out of the hands of the sheriff. If any of my men had to cut the corners any closer than I did in those days, he certainly cut them close. I know that I got the name of being close-fisted and 'near' with my money, but I couldn't see that I could help it. I had just got where I began to breathe easily, when I got into a line of work where I thought there was a good chance to have something that would grow into a good business, and after getting it going I found that it meant carrying a larger stock and getting more machinery, and of course that meant more debt, and I was soon in deeper than ever."

"You were lucky in always finding someone who was willing to let you have what you needed."

"That has always been the easiest part of it. I wish that it was anything like as easy to get out of debt as it is to get in. If a man keeps his word good, and after he has made his bargain sticks to it, he can always find lots of people who are ready and willing to supply all of his needs. He doesn't have to hunt for them—they are on the lookout for him; but, as I was saying, about the only difference that I can see between my condition when I first started in and now is that I have more property and larger debts."

"But you have made some money, too—a great deal more than you could have made if you were not in business."

"No doubt of it. I wear better clothes and live in a finer house, and travel around the country more, and am more sought after, but that comes along just like the debts and the property did. I didn't have any money to spend on clothes at first, but I soon found that there are people who judge a man by such things, and then as a matter of business I began to dress better. Often it became necessary to entertain a customer. If for no other reason I had to do it because I had received such attentions from him, and as my house and style of living did not make it at all convenient I built a house that gave me more room. The big house and the big shop seemed to spell piles of money to most people, and so I am right in line for a donation for all the charity schemes that are being urged, and to keep up my reputation I have to shell out."

"And, after all, how would you feel if you were passed by when such work was being done?"

"I don't want you to think that I am particularly finding fault with any of these things, but I am showing you how it works with some of us. We are a good bit like the farmer who lived out West. This farmer had a small piece of land, and he raised some corn on it. He fed the corn to a few hogs that he had raised. After he sold the hogs he found that he had a little surplus money, so he bought more land and raised more corn to feed more hogs, to get more money to buy more land to raise more corn, to feed more hogs to get more money to buy more land, etc., etc. His land increased, and the number of his hogs increased, and the amount of feed necessary increased, but so did his worry and his chances for loss. When his land increased so that he used up several horses in getting around, and his hogs were more numerous than the voters in his county, I am not so very sure that he was to be greatly envied by the man who does not like to hustle. He could only eat his fill after all, and he could do that before, and I do not doubt that his best pay was in seeing that he had done a good job. A man may be fit only to dig ditches or to sweep the floor of your shop, but even at that he likes to feel that he can dig a good ditch or do a good job of sweeping, and this, too, in a man who is content to dig or to sweep."

"But you don't suppose that a competent man would be content at such work? He would soon pass along to something better."

"Hold on, there. Go slow a little. You have just the kind of an idea there that I like to roast. If such ideas were not so generally held I do not think we would hear so much discussion as to whether a college education pays or not. I have known fellows in the shop who kept buying tools. Everything they could find money to pay for would be added to their stock, and yet they were not mechanics and would never be mechanics. Their tools were just as an education is to some people. Tools are only useful to people who can, and do, use them. *And education is only a tool.* All people don't put a tool to the same use, but I have never yet been able to get a tool that was self-working. There must be a user to have it of any use except to the man who made it to sell.

"If a man is born with mechanical instincts he will be a mechanic with pretty poor tools, either of education or otherwise, but if he is born without any mechanical bent all the tools in creation will not put it into him. A lot of facts crammed into the memory doesn't give ability any more than a lot of tools crammed into a tool box give skill."

"What do you serve on the school board for with such ideas, and send your own son to college for? I would like to know."

"Every fellow must have some sort of tools, no matter what he is working at, and so we put him where he has a chance to get all he can make use of; then you go into hysterics urging him to acquire a lot that he does not want and which he will never use to his own advantage. After a man has got where he is paying his own way in the world he is free, or would be if he dared to cut loose from the ideas that others preach him as to what constitutes success. If he is big and strong and likes active out-of-doors work, he may get better pay from hard work and coarse fare and vigorous health than you or I have gotten from our bigger amount of money: that is if he is contented, but he will not get it if everyone is howling to him that the only really useful, successful man is the fellow who has sold his health and leisure and enjoyment of life for the sake of accumulation either of money, property or knowledge."

"Just let's drop our work for a few days and go fishing. That will give the other fellows a chance to see if they can

work with our tools, and whether they like them or not, and it will let us get a little of that pay that does not come from the dreaded accumulation that you are telling me about."

"I'll do it. You get the bait and I'll take the grub." W. OSBORNE.

Small Cupola Practise.

BY GEO. BUCHANAN.

Small cupolas of from 12 to 20 inches diameter inside the lining require much more care in every respect before results are obtained equal to those from larger furnaces. Perhaps the chief cause of trouble in small cupolas is the difficult and almost impossible task of keeping the lining in proper condition in that three feet or so commencing a little above the tweers, the melting zone of the cupola. On account of the small size inside the lining, it is not possible for the cupola man to repair or even properly inspect the repairs done. This very important piece of work is left perforce to the very small boy who is instructed from the charging door by the furnace man what to do and how to do it, and who is also supplied with ganister lowered to him by means of a bucket and rope. Even the boy has very little room to chip off the slag and cinder which form when the furnace is used. The consequence is that the repairs are not properly executed, the ganister is not placed firmly and closely against the worn walls, but is sometimes daubed on a layer of slag and cinder, which of course melts when the fire is hot in the furnace, thus loosening and bringing away with it any ganister which has been applied. These pieces of lining descending with the charge have the effect of partially blocking or forming an arch, so that the iron and coke are not reduced to metal and slag in a uniform manner. The iron begins to be melted too high up in the stack and dropping down on to the loose pieces of lining (which have become fixed just above the tweer) is chilled and retained there until the arch is complete, and of course the furnace then refuses to melt.

Another result due to insufficient repairs in small cupolas, especially where the lining is only single brick, say 6 inches, is that before the amount of metal required for a certain heat is run out, the shell begins to get red in spots, showing that the lining is being quickly melted away. Perhaps the furnace may be full of unmelted charges when this alarming fact is noticed. The doubtful expedient of keeping the shell cool by drenching the hot place with water will avail only a very short time, so that to save the shell it becomes necessary for the furnace to be drawn at once.

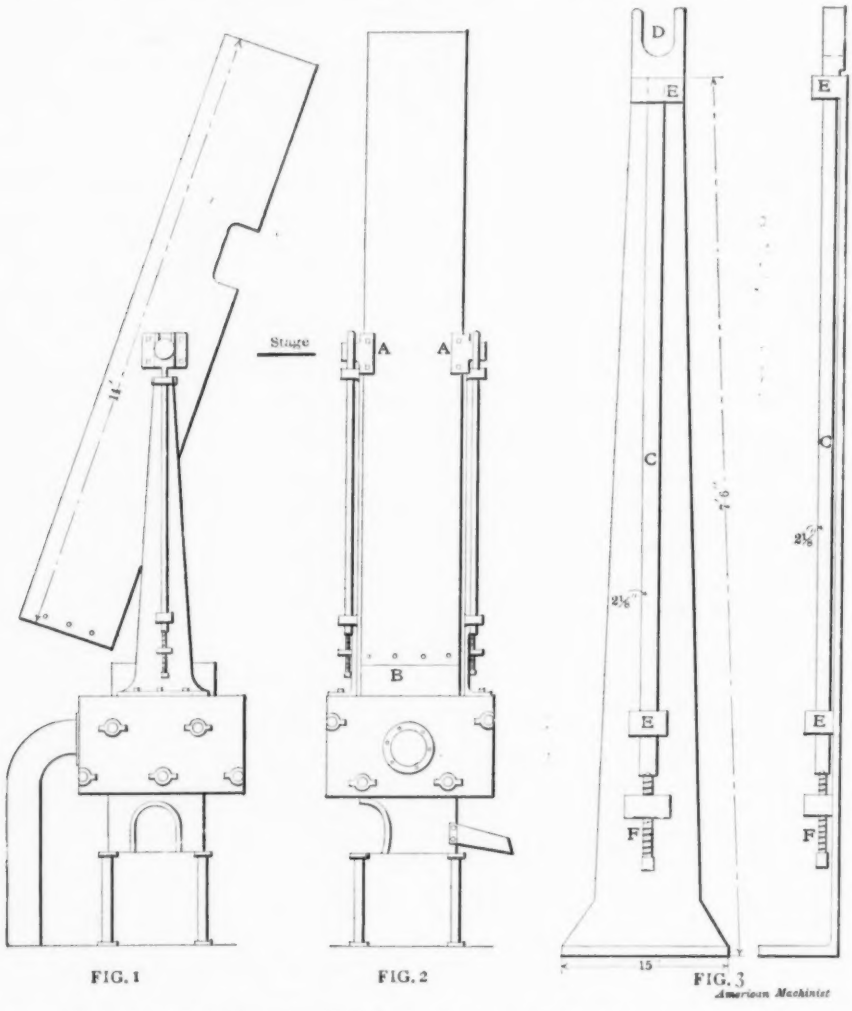


FIG. 1 FIG. 2 FIG. 3

Where cupolas are of sufficient size to allow the attendant to get inside and mend the damaged parts, such a state of things as mentioned above never happens except thru carelessness or ignorance. With small cupolas, however, the difficulties to be surmounted require special treatment, and if heats are to be run off daily, the time spent in repairs must be limited and the repairs promptly and quickly seen to. If any trouble, such as bridging of the furnace, takes place, melting operations will have to be delayed for perhaps two or three days. Such a state of things does not make the small cupola popular, and many founders are using much larger cupolas on account of this difficulty of obtaining uniform results.

The main cause of trouble, viz., repairing the lining quickly and thoroughly, may be remedied by fitting to the cupola the arrangement shown on the sketches. Fig. 1 is a front view showing the stack canted over to allow of convenient and quick repairs being done. Fig. 2 is a side view showing the position of the brackets which are bolted on to the top of the belt, also the trunnions which are bolted to the stack. The shell of the cupola is cut at *B* and small angle plates bolted around the inside of the shell to keep the lining from falling away. Fig. 3 is a view of the bracket in detail. The bar *C* is cast with the bearing *D* at its upper end and fits loosely in the two lugs *E E* and at its base the tapped lug with screw *F*. When it is desirable to repair the lining the screws are turned with a spanner which raises the shell from its bearing about 1½ inches. The stack is then swung over out of the way as in Fig. 1. The time taken to raise the stack and make ordinary repairs, and to replace the shell is about one hour. When replacing the stack a little ganister is spread on the joint, so that when the shell is let down on its bearing a tight joint is obtained. Since using this device no trouble has in any way interfered with the daily melt, and more attention can now be given to the actual melting and charging of the furnace, with a view to obtaining the most economical results in regard to the coke consumed, always remembering, however, that clean hot iron from start to finish is what is wanted and not the saving of a few pounds of coke.

The latest *nom de guerre* of the Cleveland oil swindlers is the Bolton Oil Company, which purports to be a new company, but which is equally unfortunate with its shipments of oil and addresses a proposition to a friend of ours in Cropsey, Ill., offering extra No. 1 lard oil below the regular price because it has been "shipped by mistake." We note that the Bolton Oil Company handles paints as well as oils, which is a new departure. It seems queer that the Post Office Department can so easily withhold the mail of other swindlers but can do nothing with this one.

Legal Notes.

BY E. P. BUFFET, LL.B.

It is a well-settled principle of law that an employer does not undertake responsibility to his employees for all accidents resulting from unsafe machinery, appliances or places of work, or from the faults of fellow-workmen, but he does assume to use reasonable care in selecting such machinery, workmen, etc., and is commonly held accountable for the negligence of anyone to whom he delegates this discretion. Thus, when a workman is engaged in building or repairing a machine which others in the shop are to use, he may subject the proprietor to liabilities for his negligence, in case the machine subsequently does damage as a result thereof, for which the employer could not be made to answer if the employee were acting in the capacity of an ordinary co-employee with the others. And in this case it is sometimes vitally important to know whether the accident occurred while the machine was in process of construction (or repair) or after it had been put forth as in condition ready for use; because in the former case we are to consider the man who built (or repaired) it merely as a workman engaged on a job in the shop, while in the latter case he may perhaps be held to have been, in legal phrase, the employer's *alter ego* (other self).

Upon this distinction depended the decision of the case Lindsay vs. W. R. Trigg Company, which lately was handed down by the Supreme Court of Appeals in Virginia. X—— and another workman were engaged in putting up shafting and pulleys for driving emery wheels, and it was Lindsay's duty to lace the belts. When power was applied a belt wabbled, and Lindsay was directed to hold a stick against it to keep it on the pulley while a part of the machinery was being oiled. Because of improper adjustment of the pulleys, due to ignorance or carelessness of X——, a speed of more than 4,000 revolutions per minute was given to the emery wheels, whereas they were intended to sustain, and had been tested for, only 1,500 to 1,600. In about three minutes two of the wheels burst, and a fragment injured Lindsay's hand. X—— had been in the Trigg Company's service for a long time, and there is no evidence of any previous incapacity on his part that would render the company negligent in employing him as Lindsay's fellow servant. In determining whether he might be regarded as the company's vice-principal in furnishing machinery to work with, the appeal court holds that "the machine which was being put together was incomplete until the band had been properly laced and adjusted to the pulleys." It therefore reverses the judgment of the trial tribunal which awarded damages to Lindsay. In so doing the appeal court (per Keith, P.) remarks: "If the emery wheels had not burst until this machine had been turned over and was being operated, as it was designed that it should be, in doing its part in the work of the Trigg Company, and an employee had been injured by reason of its faulty construction, it may be that ground would have existed for holding the Trigg Company liable for the injury." Thus we perceive the technicality of the law of negligence, thru which the entire matter of liability may be decided from a chance in the time an accident occurred, and—as a mind untrained to legal subtleties would be disposed to think—quite irrespective of the merits of the case. 43 S. E. Rep., 349.

Unification of German Railroads.

In these days of more or less talk regarding the government ownership or additional government control of railroads, the report from our Embassy at Berlin in relation to the experience of the Prussian government with its railways will be of interest. It is as follows:

The idea of uniting all the railways in Germany under one management appears lately to have gained ground. It will be remembered that Prince Bismarck desired to have the Empire both own and manage all the German railways, but was prevented from accomplishing his desire by the southern German governments, which feared to give too great powers to the Empire and to Prussia. Consequently the German railways were not purchased by the Empire, but by each German government individually, and those of each have been managed independently. This has caused great disadvantages to the German railways, particularly to those of the smaller governments. An example of the waste of independent management is that whole trains of freight cars are often obliged to make long return journeys empty because they belong to another government and therefore cannot be loaded. Complaints have also often been made against the Prussian government for favoring the railways of one State to the detriment of those of another. It is said that Saxony has suffered in this way.

Of late years, owing largely to the commercial depression which Germany has been passing thru the railways of the small States have not been giving good financial reports. Those of Prussia, however, on account of their great extent and excellent management, have stood the strain remarkably well.

As it seemed hopeless to secure the railways for the Empire, Prussia has for a number of years been trying to induce the other States to agree to some compromise which would secure the chief advantages of a united system while leaving the ownership to the various governments. A plan was proposed for uniting as many of the railways as possible under one management without affecting their ownership, and allowing them also to retain, to a certain extent, their individuality and national character. Up to the present only the small Duchy of Hesse has actually made such an arrangement with Prussia.

Lately, however, the initiative in this matter has been taken by some of the southern German governments themselves, which called a meeting to consider plans for uniting the management of the German railways. Accordingly, the railway ministers of most of the southern German governments met at Heidelberg during this month, where the Prussian minister of railways, Herr von Budde, joined them. The results of this meeting seem to have been satisfactory, and it now looks as though the unification of the management of all the German railways might actually take place in the not very distant future. Saxony and even Bavaria appear to be willing to support such a plan. The principal difficulty still in the way of unification is said to be the very moderate fourth-class railway carriages, which exist and are much valued in Prussia, but which do not exist and are somewhat unpopular in the southern States. This difficulty seems in a fair way to be solved.

A similar movement appears also to be on foot in the two Mecklenburg Duchies, where it is reported that a petition will be presented to the local diet for uniting the management of the Mecklenburg railways with that of the Prussian system.

Warning.

One Walter Kimball, giving his address as Hampton, afterward transferring to Richmond, Va., and claiming to own a shop and foundry at Newport News, advertised some second-hand machine tools for sale thru these columns. We are receiving complaints from many sources that this man, his tools and his shop cannot be found. His mail is not answered and he has asked for and received "freight money" in two instances that we know of. We sincerely regret that the AMERICAN MACHINIST was employed for such a purpose, but the stationery used was printed in good style and the correspondence was of such a nature as any legitimate machine-shop proprietor would have employed, and our suspicions were not in the least aroused by the order for advertising. Any information as to the present whereabouts of Mr. Kimball will be welcomed.

THE AMERICAN MACHINIST

It is reported that within a few weeks the Standard Oil Company will begin to pump oil from wells in Indian Territory to its refineries in Greater New York. The line will be 2,000 miles long, the route being from Red Fork, to Kansas City; Whiting, near Chicago; Cygnet, Ohio; then to Pennsylvania, to Olean, N. Y., across New Jersey and under the Hudson and East rivers to Greenpoint, N. Y.

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Work Enough.

As far as can now be predicted, we are beginning a year of industrial activity and prosperity. Most of our readers are undoubtedly congratulating themselves that the outlook for business and the promise of work in sufficient quantity to keep tools and men employed up to or above the normal rate of production, and with a fair prospect that operations will not be unremunerative, are decidedly better than they were a year ago. We congratulate our readers upon the outlook and offer our best wishes for its fullest realization. At the same time when it comes to talking of work in sight the expressions of an editor of a technical paper are necessarily more or less perfunctory. We have to say, as not all connected with the machine trade can say, that in no year of our existence have we had more to do or have actually done more than in the year just closed. We have at least one thing upon which to constantly congratulate ourselves. Whatever may be the state of the market or the prospects of trade, there are no slack times with us, and we know not, individually or collectively, what it is to be out of a job. The question with us in the work of making the paper always is not what to do but what to do first. It is true that in the style and burden of our work there has been a decided change with the advancing years. There was a time when the mere filling of our pages, then much fewer than now, with anything and everything which had any plausible mechanical pretext for appearing in our columns was an unceasing load upon the editorial mind. That anxious and draggingly laborious time is now happily past, and the burden of our occupation is now largely that of selecting and adapting sufficient for our purpose from a mass of material always much larger than can be used. This in a way carries with it a suggestion of more or less work that is unprofitable, as in the strenuous and resolute reading of manuscript not too legible and the puzzling over sketches or alleged drawings which strain the eyes and still more try the imagination only after all to return it to the author "with thanks for the privilege of examination," yet if we are permitted to pick out the best peck from a barrel of apples our peck can hardly fail to be above the average, and much better than a peck of windfalls. It may be scarcely for us to say whether or not this larger opportunity for selection actually has resulted in this higher average for the material secured, but it would be difficult to persuade any sane person that it has not.

The AMERICAN MACHINIST as it comes to the reader may be looked upon as a sandwich, with the meat of course in the middle, but the bread as well as the meat to contribute to the sustenance and growth of those who absorb and assimilate the whole. Those who do not with satisfaction and profit thus absorb and assimilate the whole do not get all the good they are entitled to and which they might so easily appropriate to their upbuilding. Those who do get the good of the whole will doubtless rejoice with us that our sandwich is bigger than a year ago. With a choicer selection of meat in the middle there was also eighteen per cent. more of bread in the last issue of the year as compared with that of a year ago. It is evident that the providers of the bread, the editors and writers and artists and designers of the advertising pages also have had their hands full, so that they, too, may congratulate themselves that they have not known a day of slackness in the past year, and upon the substantial evidences they have received that their labors have been appreciated. It is, then, with abundant reason for satisfaction that we can regard our completed work for the year that we have left behind, and we can with unalloyed sincerity thank our friends all for their support and the substantial evidences of their appreciation during the year, and we can scarcely offer all a better wish than that they may be as busy throughout the year now begun as it is reasonably certain we shall be.

A Home Study Course.

No reader who feels the need of going about the getting of a technical education in a systematic way should fail to read the article which we publish on another page of this issue under the title of "A Home Study Course." And any of our readers who may themselves not need or not find it possible to pursue the course there outlined, but who may know of young men who might profit by it, may confidently commend this article. It is written by a man who thoroughly knows whereof he affirms, and the unerring certainty with which he points out the difficulties that will present themselves and the best method of overcoming them is admirable and well calculated to inspire confidence. The young man who reads this article and who for any reason cannot pursue one of the better plans mentioned by Mr. McCullough, should make a beginning at once on the one described by him. Say what one may, it is becoming increasingly important that men who seek success in mechanical lines should possess the sort of knowledge that is to be gained by such a course of study faithfully followed out, and he who waits for this education to be handed to him will have a long wait and finally go without. There is no way except to work for it; and this is fortunate instead of unfortunate, because the work itself is beneficial.

We hope that many young men will be inspired by Mr. McCullough's article to make a beginning, and that having once begun they will go on to the end. Every advance made is so much gained that will be useful whether the student goes further or not. Some of the best educated men have been almost entirely self-educated.

New Tools and Machine Shop Appliances.

MOTOR-DRIVEN TAPPING MACHINE.

The Garvin Machine Company, of New York, is now fitting its No. 2 Automatic Tapper with motor drive in the manner shown. A variable-speed motor having a range of 900 to 1,800 revolutions is geared down by spur gear and pinion to drive

MOTOR-DRIVEN TAPPING MACHINE.

the pulley at the base, which is then belted up to the spindle in the regular way. The variable speed of the motor serves the function of a cone pulley, and no change gearing is needed. But one belt is used to drive both forward and reverse pulleys, on the spindle; this being accomplished by looping the belt around the idlers. A bevel friction, operated by a toggle, plays between the friction pulleys on the spindle. The spindle is operated by the lever on the side, the same movement throws in the friction clutch, and a latch holds it in. As the spindle feeds down, an adjustable collar on the spindle trips the latch, and the friction clutch then flies over into the reverse pulley. The reverse is independent of the pressure on the lever. The friction can be adjusted very closely to suit the tap, so the friction will slip and avoid breaking the tap, no safety device being needed; and the automatic trip secures uniformity in working.

The machine can be arranged to operate by treadle, or two heads can be mounted on one column.

A NEW GENERATING SET.

We illustrate herewith a new self-contained generating set, which is the product of the B. F. Sturtevant Company, of Hyde Park, Mass. Referring to the engine, the reciprocating parts are counterbalanced by lead loaded disks, the crank shaft being forged solid and the disks shrunk on it. The governor is of the Rites type, giving a regulation between full and no load of from 1 to 1½ per cent., and the valve gear is a modification of the Marshall gear, which provides a range of cut-off from zero to 70 per cent. of the stroke. A water-shed partition is provided in front of the stuffing box, which prevents water from the piston rod from reaching the interior of the engine frame and oil on the reciprocating parts from being thrown into the engine-room.

The main frame is enclosed on both sides by removable plates, and the crank webs are enclosed by a gray-iron hood having two holes with removable covers, one for the purpose of cleaning the crank-pin box while it is in motion, and the other for removing the box without taking off the large hood. Between the water-shed partition and the front end of the cylinder is a hand-hole for reaching the stuffing box bolts without communication to the oil spaces.

Two oiling systems are used with this type of engine, the gravity or tank system and that by forced pump lubrication. With the gravity or tank system, shown in the illustration, an oil tank supplies the pipes leading to the parts to be oiled. At each point where the oil is delivered is a little gage glass and valve for regulating the flow at that point. A valve just below the tank regulates the entire oiling system.

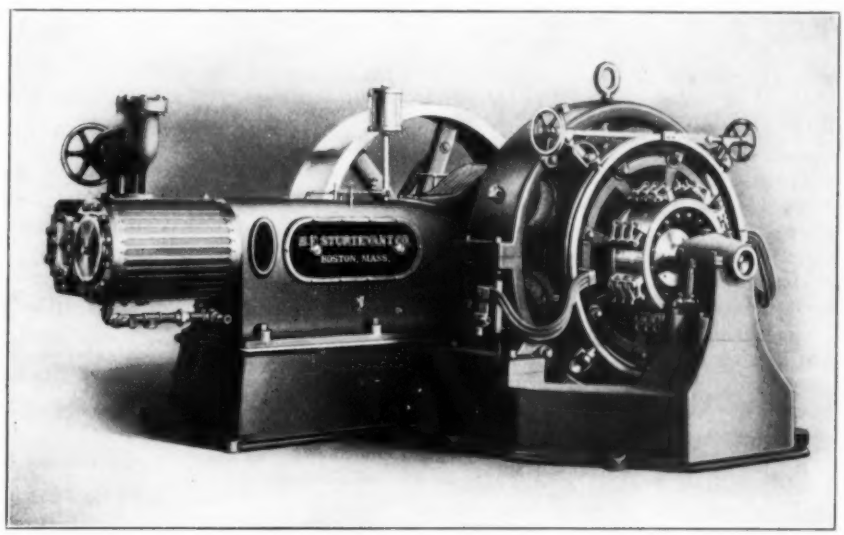
With the pump or forced lubricating system, a pump is located in the base of the engine and is operated by the crankshaft. Oil is delivered from this pump to the main bearings and from the main bearings thru holes in the crankshaft and web to the crankpin. From this point the oil is conducted thru a hole in the connecting rod to the crosshead pin. A separate set of pipes conveys the oil from the crosshead guides to the valve stem guides. The pressure of oil in the bearings under this system will vary from 12 to 18 pounds per square inch. The mechanical efficiency of the engine is found to be materially increased by this system of lubrication and the demand for it is rapidly increasing.

The generator is of the eight-pole type, and is capable of carrying momentary overloads of 50 per cent. without any shifting of brushes or flashing of the commutator and an overload of 25 per cent. for a period of two hours without undue heating. After a continuous run of ten hours at full load, the increase in temperature above that of the surrounding air never exceeds 40 degrees Cent. upon the armature and field coils and 45 degrees Cent. upon the commutator. The average temperature rise is about 33 to 35 degrees Cent. Before being shipped, the generator is given a break-down test of 1,500 volts, alternating for sixty seconds between the conductors and the frame of the machine to test the insulation.

The magnet frame is of gray iron, split horizontally. The pole pieces are of wrought iron with gray-iron shoes or horns and are secured to the magnet frame by thru bolts. Any of the pole pieces may thus be removed to repair the field coils. The latter are wound in two sections, with an air space between the shunt and series coils. The shunt winding is of double cotton covered magnet wire, thoroughly insulated and so treated as to be practically waterproof. The series winding is of copper bars insulated in the same manner as the shunt coil.

The armature is of the iron-clad, form wound, ventilated drum type, having a core built up of charcoal-iron plates, which plates, after being thoroughly japanned, are mounted upon a gray-iron spider and securely held in position by end flanges. No bolts pass thru the armature laminations. The armature spider has an extension upon which is mounted the commutator, making the armature and commutator one unit.

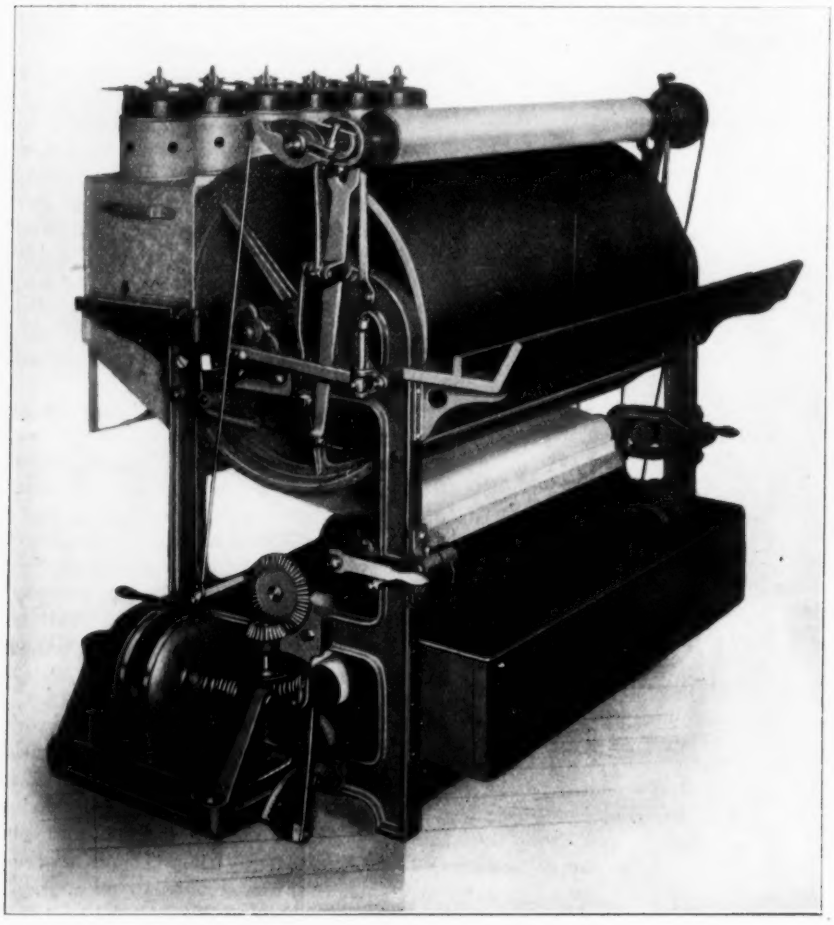
The armature conductors are solid cop-



A NEW GENERATING SET.

per bars, without joints except at the commutator end. When these bars are formed they are insulated by material not perceptibly affected by heat nor by ordinary atmospheric moisture.

In the construction of the commutator, only drop-forged or drawn segments are used, these being secured in gray-iron shells of spider construction and clamped in place with a steel ring. No cast segments are used. The segments are insulated with selected mica of a degree of hardness to allow the mica and segment to wear uniformly, thus obviating trouble from high mica. The end insulation consists of micanite rings and the whole commutator is assembled while hot, under pressure. Carbon brushes are used, the commutator being so proportioned and the brushes being of such size as to allow at least one square inch of brush area to every 30 amperes carried. These brushes are carried in holders mounted upon a self-contained brush rigging so arranged that the entire set of brushes may be rotated completely around the commutator. Hand-wheels are furnished for adjusting the brushes, these hand-wheels being so located that the brushes may be adjusted from either side of the generator.



CONTINUOUS BLUEPRINTING MACHINE.

BLUEPRINTING MACHINE.

At page 874, Vol. 25, we published a description of the Federal continuous blueprinting machine made by the Spaulding Print Paper Company, of 44 Federal street, Boston, Mass., but recent improvements make it advisable to illustrate it again, which we do herewith.

The tracings and prepared paper are fed in between the revolving drum and a transparent apron of tracing cloth whence they travel around in front of a row of arc lamps at the further side and are eventually discharged into the box at the bottom. The drum is driven by a small motor. The printing is upon a continuous roll of blueprint paper and the length of tracing which can be printed from is only limited by the length of the apron. The speed of the drum is variable by means of the speed variator shown in the foreground near the floor in order to accommodate varying intensity of illumination and sensitiveness of paper, this speed range running from about three to about eight feet per minute. After running out the length of the apron it is rewound upon its roller and the process is repeated.

TWO THREADING DIES.

The Oster Manufacturing Company, 84 E. Prospect St., Cleveland, O., has brought out two new threading dies. Fig. 1 shows the die for use in the turret lathe. This die is of the well-known pattern of quick-opening dies. The chasers are four in number,

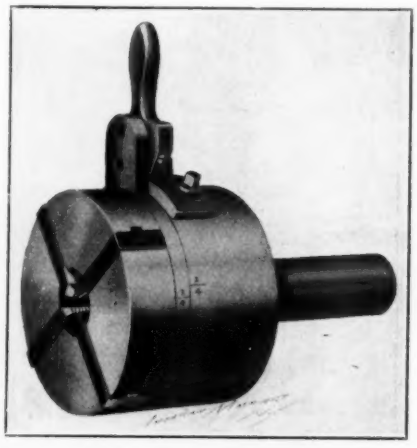


FIG. 1. OPENING DIE FOR TURRET LATHE.

being set to size and released by revolving the cam plate which engages the chasers by a cam leaf locking in a corresponding groove in each chaser. This tool has no automatic knock-off, as it is intended for use on jobs so short that the operator cannot run two machines. The tool is set by releasing the set-screw (shown in Fig. 1 just below the lever) and moving to size according to the graduations shown on the body of the tool. The set-screw is then tightened and duplicates can be threaded by setting with the lever only. This lever is also used for quick release of the chasers when the thread is complete.

Fig. 2 shows a machinist's screw plate. With many screw plates having adjustable guides it is impossible to thread work right up to a shoulder, owing to the interference of the guides. In this plate this objection has been obviated by making the guides detachable. The method of actuating the chasers in and out is the same as in the one for power—*i. e.*, by means of a cam

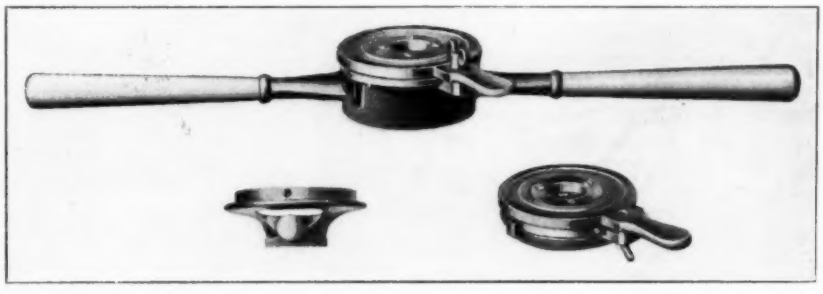


FIG. 2. MACHINIST'S SCREW PLATE WITH DETACHABLE GUIDE.

plate. This plate is furnished with solid guide bushings instead of the adjustable guide if so desired. In Fig. 2 below the screw plate are shown: to the right the removable adjustable guide and to the left the removable collet for the solid guide bushings.

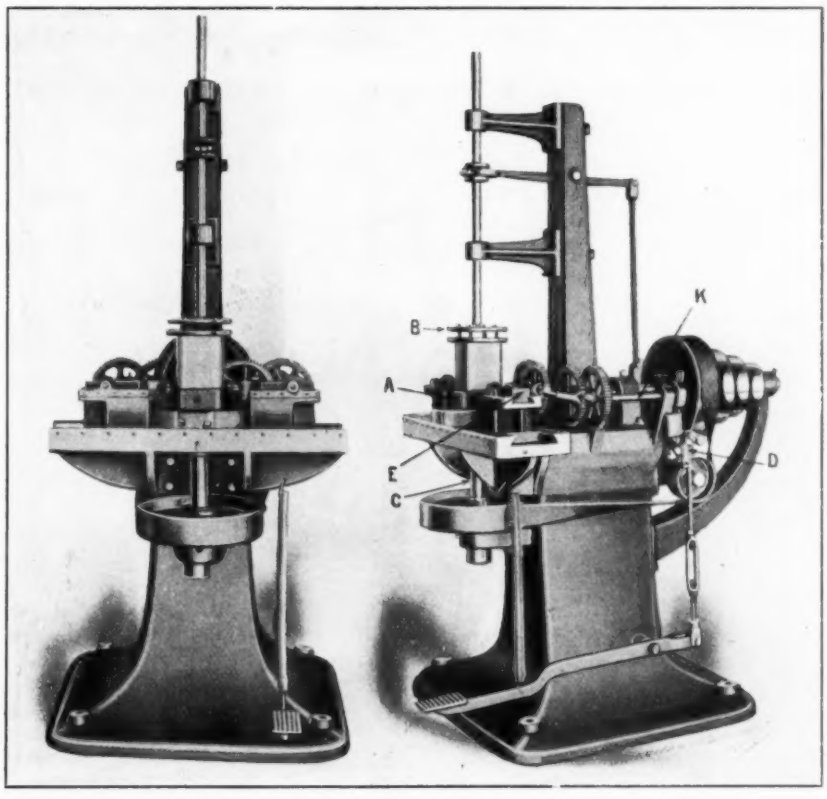


FIG. 1. CAN SEAMING MACHINE.

CAN SEAMING MACHINE.

The engravings herewith illustrate a can seaming machine for putting the bottoms on square or irregular shaped tin cans as well as round ones; it is simple in its construction, easily changed from one size to another, and quick in its action. The bottom of the can is placed on the chuck *A*, Fig. 1, and the can body on top of the bottom; then the foot treadle is depressed, bringing down the vertical spindle until the cushion plates *B* rest on top of the can. By this time the chuck spindle *C* and the work will commence to rotate, a friction clutch in the driving cone which is running continuously being thrown into action by the pull of the treadle, and then the rod from the treadle is automatically locked by a stop at *D* so the foot can be removed while the machine completes its cycle of operation and the work is finished, upon which the lock for the operating mechanism automatically releases the friction drive and the machine stops. On the end of the main shaft is a 20-tooth gear meshed into one with 60 teeth, to which is attached another 20-tooth gear meshing into a second 60-tooth gear, so the speed of driving and driven shafts will be in the ratio of 9 to 1. The last gear in the train is connected, as shown, by a telescopic shaft and universal joints to a cam shaft in a slide *E*, which shaft will revolve with its cam and join can body and bottom while the can is making 4½ revolutions. The gear train, slide and cam, it will be noticed, are duplicated, so there is really a pair of cams operating simultaneously on opposite sides of the work as shown in the front view. In Fig. 2 one of the pair of cam shafts is shown at *F* and the slide *E* which it operates carries at the front end the roll which acts upon the parts to be joined, the bottom of the can with the body placed upon it resting on chuck *A*, as previously explained. About *A* is formed a cam path to receive roll *G*, which path is made to conform to the shape of the cam. As the work rotates, slide *H* carrying slide *E* is controlled by the roll *G* guided in its channel, and at the same time the seaming roll *I* is fed to the work by cam *J* on shaft *F*. The forward feed is accomplished while the

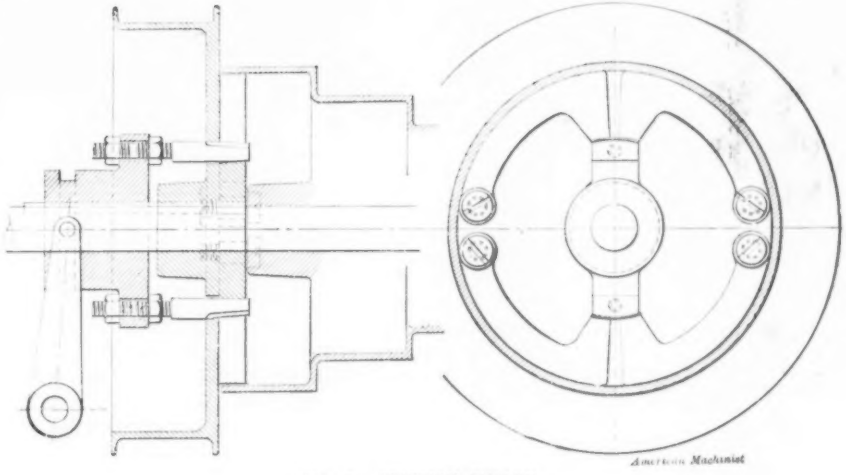


FIG. 3. FRICTION PULLEY.

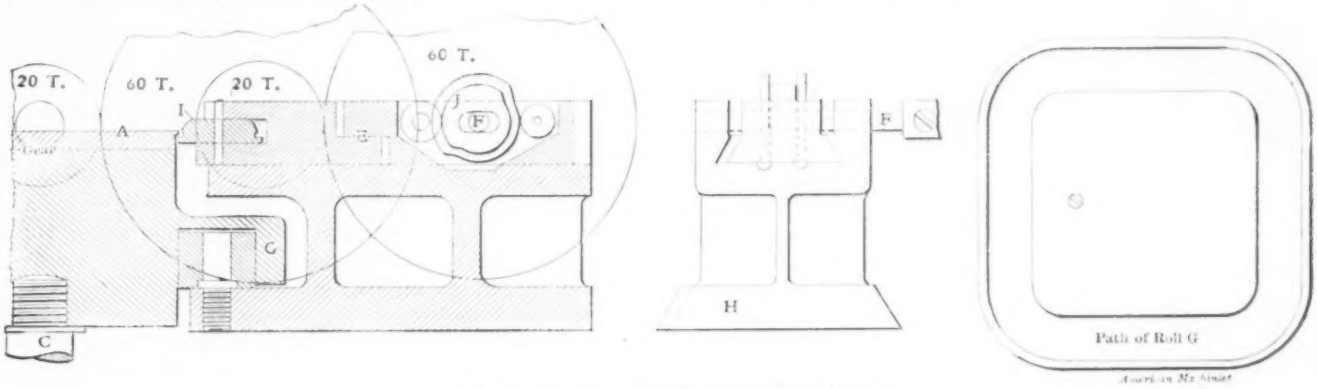
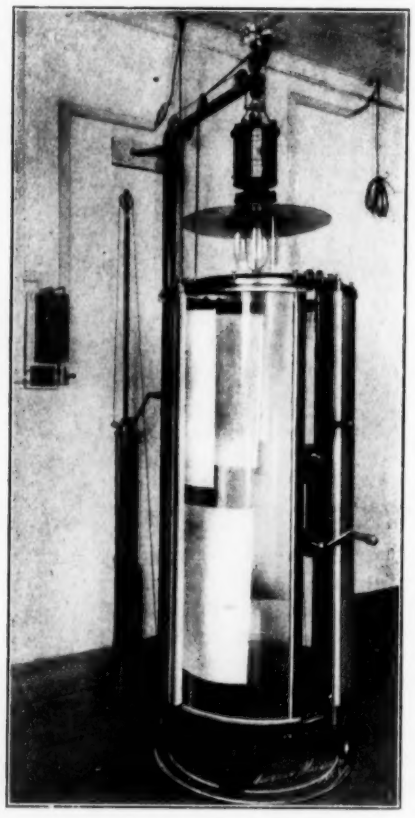


FIG. 2. SHOWING ONE OF THE PAIR OF SLIDES.

can is making 4½ turns, as above, then the larger cams—one at either side of *J*—withdraw the roll from the work. Upon the completion by the cam shaft of one rotation the machine automatically stops and the vertical spindle lifts to allow the work to be removed. The friction referred to is shown in Fig. 3, and consists principally of an internal band formed in four parts, each pivoted at one end, and expanded in the pulley by a pair of adjustable wedges operated by a sliding block on the shaft. The action of depressing the foot lever throws this block forward, where it remains until the completion of the work, when a pin on the shaft *K* strikes a dog on the lock at *D*, Fig. 1, and releases the friction. The spindle for holding the work may be adjusted to a hight of 18 inches from the chuck and cans from 1½ to 10 inches square may be handled under it. The patentee of this machine is August Wulff, 1220 Fortieth street, Brooklyn, N. Y.

ELECTRIC BLUEPRINTING MACHINE.

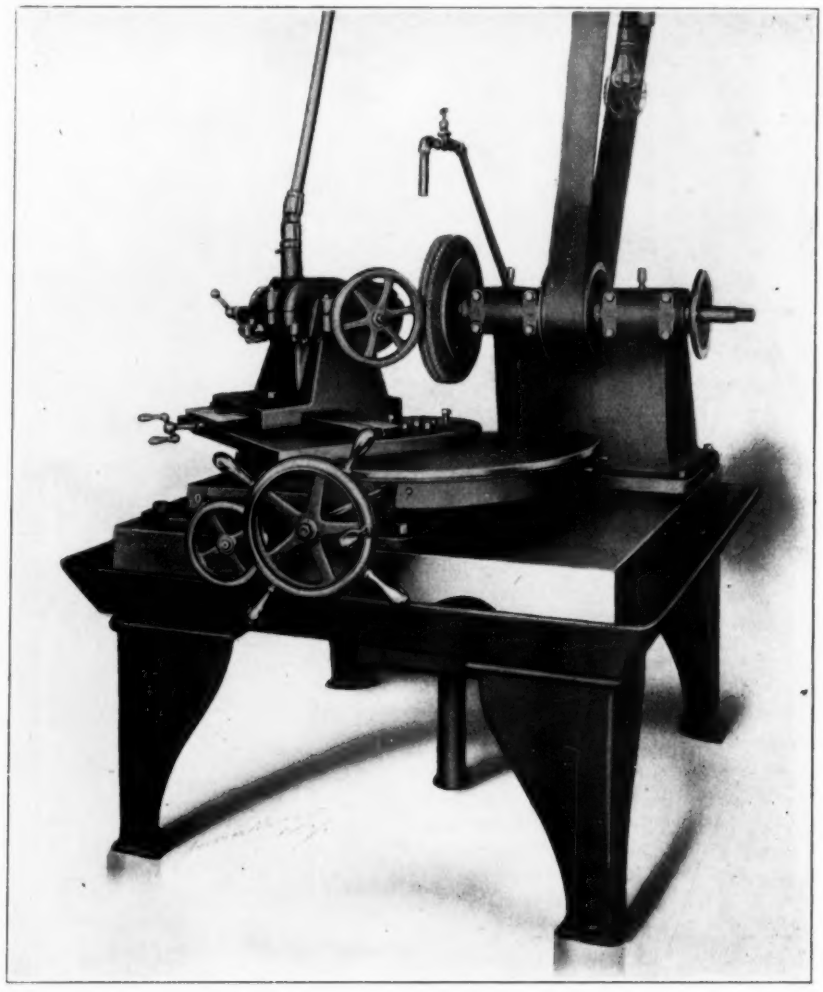
The accompanying illustration shows a blueprinting machine which is the product of the Keystone Blue Paper Company, of 910 Filbert street, Philadelphia. The glass cylinder has no trunnions and remains permanently in the upright position. The curtains are mounted upon rollers and by turning the cranks shown they are wound or unwound over the cylinder, as the case may be, tension being maintained by springs. The cranks are provided with automatic stops by which the rolls may be held in position at any point, thus facilitating the insertion of small tracings. The lamp, which is specially constructed and of high actinic power for quick printing, is provided with light screens above and below it which cut off the slanting rays of light and thus facilitate the making of sharp prints. The lower screen serves also to protect the paper from the light when loading the machine, thus making it unnecessary to extinguish the light when loading, and the upper screen cuts off the light at once when the lamp has finished its descent. The lowering device is hydraulic and is regulated by turning a valve.



ELECTRIC BLUEPRINTING MACHINE.

HAND-WHEEL GRINDING MACHINE.

The object of this machine is to finish the rim of the hand wheel from the rough at one operation, ready for the buffer, without machining it with a tool. The bed consists of a planed casting 3 feet 7 inches by 3 feet 5 inches, mounted upon a cast-iron pan on legs. At the back of the bed-plate is fixed the grinder head, and in front is a dove-tailed slide, having 17½ inches of bearing for the swivel slide. This swivel slide has a cross-feed of 13 inches to and from the grinder head, and upon it is mounted a second slide with its center fixed upon the swivel slide in line with the grinding wheel so as to center all diameters. A rotary movement is provided for the second slide by the pilot wheel shown in front. A cross-adjustment is provided for the head block carrying the hand wheel to be ground, and the spindle holding the hand wheel is also adjustable so as to bring different diameters of hand wheels directly over the swivel center. The speed of the hand wheel to be ground is controlled thru a shaft, with universal joints driven from a variable speed countershaft. It is stated that on certain hand wheels the time has been reduced by this machine from one hour to nine minutes each. The builders are the Lodge & Shipley Machine Tool Company, Cincinnati, Ohio.



HAND-WHEEL GRINDING MACHINE.

Lectures on Mechanical Engineering Subjects.

The Polytechnic Institute of Brooklyn is about to inaugurate a series of strictly technical evening lectures on various engineering subjects, attendance on which is required by students of the Institute but which are also open to others on payment of a fee. There are to be five courses in all, covering heating, ventilating and lighting various classes of buildings, elevator

service and elevators, fans and mechanical draft, preparation of bituminous and anthracite coals, and refrigeration.

The Romance of "Only a Machinist."

A firm of machinists in New York, who have a good deal to do with printing presses, prints in a folder the following story by Artemus Ward, which story had before escaped our notice:

In a sumptuously furnished parlor in Fifth avenue sat a proud and haughty belle. Her name was Isabel Sawtelle. Her father was a millionaire, and his ships, richly laden, ploughed many a sea. By the side of Isabel sat a young man with a clear, beautiful eye and a massive brow.

"I must go," he said; "the foreman will wonder at my absence."

"The *foreman?*" asked Isabel, in a tone of surprise.

"Yes, the foreman of the shop where I work."

"Foreman—shop—*work!* What! Do *you* work?"

"Aye, Miss Sawtelle! I am a machinist!" and his eyes flashed with honest pride.

"What's that?" she said; "it's something about machines, isn't it!"

"It is!" he said, with a flashing nostril. "And presses."

"Then go!" she said in a tone of disdain—"go *away!*"

"Ha!" he cried, "you spurn me, then, because I am a mechanic. Well, be it so, tho the time will come, Isabel Sawtelle," he added, and nothing could *exceed* his looks at this moment—"when you will bitterly remember the machinist you now so cruelly cast off! *Farewell!*"

. . . . . .

Years rolled on. Isabel Sawtelle married a miserable aristocratic printer, who recently died of delirium tremens. Her father failed, and is now a raving maniac, and wants to bite little children. All her brothers (except one) were sent to the penitentiary for burglary, and her mother peddles clams that are stolen for her by little George, her only son that has his freedom. Isabel's sister, Bianca, rides an immoral spotted horse in the circus, her husband having long since been hanged for murdering his own uncle on his mother's side. Thus we see that it is always best to patronize practical machinists.

Technical Publications.

"The Mechanical World Pocket Diary and Year Book for 1905." 302 4x6-inch pages with numerous illustrations and tables. The Mechanical World, Manchester, England. Price 6 pence.

In this, the eighteenth annual edition of an excellent pocket book, we find new tables giving the squares, cubes and fourth power of fractions, the powers, roots and reciprocals of various constants, ball bearings and gages. Of all the pocket books with which we are acquainted this gives the largest value for the smallest sum. It contains a large amount of information and its price is phenomenally low.

"Fowler's Mechanical Engineer's Pocket Book." Revised edition for 1905. By Wm. H. Fowler. 498 3¾x6-inch pages, with numerous illustrations. Scientific Publishing Company, Manchester, England, price 1 shilling 6 pence; The Derry-Collard Company, New York, price 75 cents.

We have noticed the annual appearance of the revised editions of this excellent pocket book as they have appeared. The present edition contains material additions of which one of the best is a condensed discussion of entropy and its application to steam practise. Other additions relate to steam turbines, high-speed steel, emery grinding, milling and reaming. The book is especially useful as a machine designer's pocket book and contains much that would be difficult to find elsewhere.

"A. L. A. Catalog. 8,000 Volumes for a Popular Library with Notes." Prepared by the New York State Library and the Library of Congress under the auspices of the American Library Association Publishing Board. Edited by Melvil Dewey, May Seymour and Mrs. H. L. Elmendorf. 888 7x9½-inch pages. The Government Printing Office, Washington, D. C. Price in paper cover 25 cents, in cloth cover 50 cents.

This volume is the outcome of a proposal which was first made before the American Library Association at its Boston meeting of 1879. It is the result of a vast amount of work and of the co-operation of many workers. Its purpose is sufficiently indicated by its title and it will no doubt serve an extremely useful purpose.

Personal.

Our contributor, Corneil Ridderhof, has been appointed manager of the Wilmarth & Morman Company, of Grand Rapids, Mich., with which company he has been connected for some time.

C. W. Whitney has resigned his position as Pacific Coast representative of the McGraw Publishing Company, New York, and has become identified with the Abner Doble Company, of San Francisco, engineers and manufacturers of tangential water wheels and needle regulating nozzles. Mr. Whitney will have charge of the Abner Doble Company's publicity department.

Manufacturers.

The plant of the Globe Soap Company, Cincinnati, O., has been damaged by fire.

The Roseland Can & Specialty Company, Rockford, Ill., has been incorporated.

The Goldy Machine Company is building a plant at Sunnyvale, near San Jose, Cal.

The Cleveland City Forge & Iron Company, Cleveland, O., is making plant additions.

The Hannibal, Mo., shops of the Burlington will probably be enlarged immediately.

D. P. West, Montgomery, Ala., is promoting a proposed ice factory and electric plant.

A canning plant will be erected at Pittsfield, Mass., by the Pittsfield Canning Company.

G. A. Bozeman, Suffolk, Va., is mentioned in connection with a proposed cotton yarn factory.

The American Pulley Company, Philadelphia, Pa., will erect a 50x180-foot machinery building.

The Dorcas mill, at Florence, Colo., treating Cripple Creek ores, proposes doubling its capacity.

Mickle & Cheney, woolen mills, Mechanicsburg, O., are thinking of rebuilding; location in doubt.

Fire is reported to have damaged the factory of the Central Chair Company, Indianapolis, Ind.

Stuckstede & Bro., bell founders, St. Louis, Mo., have bought a lot on which to extend their plant.

It is rumored that the Louisville & Nashville is about starting to build shops at Etowah, Ga.

The plant of C. E. Littell, Cincinnati, O., manufacturer of porch columns, etc., has been burned.

The Mandt Wagon Company, Stoughton, Wis., and elsewhere, will erect a new factory at that place.

The Hamilton Ice & Cold Storage Company, Chattanooga, Tenn., is about to enlarge its plant.

There is a beet sugar factory project at Prairie du Chien, Wis. The mayor is conversant with it.

A new factory building for the A. H. Nilson Machine Company, Bridgeport, Conn., is being completed.

The Napoleonville (La.) Ice Factory Company has increased its capital stock and will build a new plant.

The David Chapman Brick Company has applied for a site at Toronto, Ont. It has a capital of $50,000.

The United States Oil Extracting Company is to build a factory at Decatur, Ill., to extract oil from corn.

The Otis Elevator Company, Yonkers, N. Y., is reported to have secured two blocks for a factory at Houston, Tex.

The American Pin Company, Waterbury, Conn., has been having preliminary sketches made for a new factory building.

The Bronson-Walton Company, kitchen hardware specialties, Collinwood, O., is building an addition to its plant there.

The Lorain & Elyria Ice & Coal Company has for some time been considering whether to enlarge its plant at Elyria, O.

The William Tinkham Company, woolen goods, Harrisville, R. I., proposes to build a yarn mill, three stories, 156x54 feet.

The Village of Milverton, Ont., is considering a loan to a shoe manufacturing company which is proposed to be organized.

It is reported that a plant near Perkinsville, N. Y., of the Wayland (N. Y.) Portland Cement Company has been burned.

A canning and packing house for oysters and other products may be built near Mobile, Ala., by I. S. Farren & Co., of Baltimore, Md.

Woolen mills are proposed for Kansas City. James Donohue, secretary of the Manufacturers' Association, is in touch with the project.

The W. H. Sweeny Manufacturing Com-

pany, tea and coffee pots, Brooklyn, N. Y., will erect an eight-story building additional.

It is rumored that the Cable Company, pianos and organs, Chicago, Ill., may build a Southern plant in Charleston, S. C., or elsewhere.

Plans have been filed for an addition, 68x120 feet, to the plant of Chas. Ervien & Co., machinists, at Venango & G streets, Philadelphia, Pa.

The Modern Manufacturing Company is building a factory in the Eastside Syndicate addition, Spokane, Wash., to make farming machinery, etc.

The St. Joseph (Mo.) Artesian Ice & Cold Storage Company is seeking a franchise to pipe ammonia thru the streets for general refrigeration service.

The Linderman Manufacturing Company, wood-working machinery, of Whitehall, Mich., will, it is reported, move to Muskegon, increasing its facilities.

The general contract has been let to erect a 66x100-foot, two-story building for the National Brass & Metal Company, plumbers' supplies, Minneapolis, Minn.

The North Attleboro, Mass., shop of the United Brush Company has been gutted by fire. The company will arrange to continue its business at that place.

The location of a coal washery at Kankakee, Ill., is being discussed. The Madison Coal Company, St. Louis, Mo., is understood to be connected with the project.

Messrs. Ray and Baxter, said to represent the National Clock Company, of Cleveland, O., have rented an office in Oxford, O., and a factory for that place is talked of.

A packing plant is to be built in Chicago by P. & B. G. Brennan, a new independent concern. Plans by Zachary T. Davis call for a five-story, 100x210-foot building.

The Wellington Manufacturing Company, corn starch, of Lititz, Pa., and elsewhere, is building a plant at Marion, Ind., and proposes to increase the Lititz plant.

Schwarzschild & Sulzberger Company, of New York city and elsewhere, is expected to build a big packing plant at Sioux City, Ia., but its plans are not yet announced.

The Andrew Fyrberg Arms Company, Hopkinton, Mass., has been inquiring for a factory building at New London, Conn., and not readily finding one, may locate in Meriden.

The J. G. Leyner Engineering Works Company, Denver Colo., is bringing to completion the large shops it is building at Littleton for the manufacture of mining machinery, etc.

The Chamber of Commerce, Huntsville, Ala., is in correspondence with a manufacturer who may establish a mill there to make rope and twine from waste cotton products.

The Dane County Sugar Refining Company, newly organized, has established headquarters in the store of Krehl & Son, Madison, Wis., and proposes to build a plant near Burke.

The Studebaker Bros. Manufacturing Company interests, South Bend, Ind., are reported to have let the contract for a big factory there to make gasoline and electric automobiles.

Projects relating to a public market are being discussed by committees of the Rochester, N. Y., Common Council. Chas. P. Elliott has a refrigerating plant scheme in connection therewith.

Geo. Wenger, St. Louis, Mo., has secured factory property which he will use for machine shop purposes, etc. From our information it is not clear whether the same is in St. Louis, but so it appears.

A company with $25,000 capital stock has been formed and may place a hoop and stave mill at Henderson, Ky. Among those interested are Wm. L. Alves, of that city, and Wm. O'Keefe, of Plymouth, Ind.

The Star Glass Company has been organized to build a factory for pressed glass ware at Randall, W. Va. Ground has probably been broken by this time. Geo. E. Cleveland, of Rochester, Pa., is among those interested.

G. L. Shumway, Scotts Bluff, Neb., has organized an electric power plant company proposing to operate on the North Platte River near Gering. The name of the concern is the Pathfinder Electric & Water Power Company.

Chase & Bolles, Toledo, O., will erect a factory to make pens. They will incorporate a company, and the business will, we understand, be known as the Standard Self-Filling Fountain Pen Company, with offices in the Spitzer.

The Byron-York Machinery Company, 417 Spring street, Pueblo, Colo., has lately completed new quarters, but its business is such that it will make an immediate further enlargement. It manufactures the Byron gasoline engine.

The Waite Gas Engine Company is being organized to manufacture the engine invented by H. C. Waite, and has opened an office in the Montgomery Building, Milwaukee, Wis. It is planned to establish a factory at Milwaukee. Besides the larger engines Mr. Waite has in view an automobile motor.

The plant of the J. Thompson & Sons Manufacturing Company, Beloit, Wis., farm implements, gas engines, etc., was lately visited by a serious fire, but the company arranged for speedy resumption of work and will probably be turning out implements again in a few days, if it is not doing so already.

A regular feature of the annual report of Factory Inspector Geo. L. McLean is a list of idle factories in the State of Connecticut, which can be operated by steam, water or other power. This furnishes ready information to manufacturers who may be seeking a location. Out of those mentioned in the 1901 report—thirty-three in number, we understand—ten are now running.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Addressing machines for office use. Joline & Co., 123 Liberty St., New York.

Designer of tool and automatic machinery. Fred Mill, East View, Cincinnati, O.

Wire and sheet metal working machinery and tools. Emmons Collins, Chicago.

Light mach'y to order; model work; rubber molds. J. W. Weir, Bridgeport, Conn.

Mark your tools; a 3-initial stamp, 50 cts., post paid. J. L. Lucas, Bridgeport, Conn.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Working drawings, tracings. Geo. M. Mayer, M. E., 1131 Monadnock, Chicago, Ill.

Wanted—Bids for manufacturing an article similar to a safety pin. A. W. Smith, Box 337, Blairsville, Pa.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Patented improvement on machine tool for sale or manufacture on royalty. Address C. J. Dailey, So. Bethlehem, Pa.

Auto. machinery of all kinds designed and built; hardened and ground work, flat or circular. Wiebking, Hardinge & Co., Chicago.

Wanted—To hear from party who can manufacture and develop new tool for machinists and millwrights. Address Box 722, New Kensington, Pa.

Special machinery and tools designed and built; inventions developed; machines improved and perfected. Blair Tool & Mach. Wks., 24-27 West st., New York City.

The Canada Machinery Company, Limited, Sarnia, Canada, have the facilities and are open to manufacture, for patentees and others, machines and machinery for the Canadian market.

The annual meeting of the stockholders of the Derry-Collard Company, for the election of directors for the ensuing year and for the transaction of such other business as may properly come before the meeting, will be held at the company's office, Nos. 256-7 Broadway, Borough of Manhattan, City of New York, N. Y., on Tuesday, January 10, 1905, at six o'clock in the afternoon. Dated New York, December 22, 1904.

ALBERT W. POLLARD, Secretary.

The annual meeting of the stockholders of the Hill Publishing Company, for the election of five directors for the ensuing year and for the transaction of such other business as may properly come before the meeting, will be held at the office of the company, in the Pulitzer Building, 63 Park Row, Borough of Manhattan, New York city, N. Y., on Monday, January 9, 1905, at 12 o'clock noon. Dated, New York city, December 5, 1904.

F. R. LOW, Secretary.

Business Opportunities.

A successful, growing, Cincinnati concern, manufacturing patented machine tools for past ten years, feels the need of an up-to-date, hustling business manager, willing to invest at least $10,000. Address Box 62, A. M.

Wanted—Treasurer, investing $10,000, in a high-grade, old manufacturing company. Has always been dividend paying; present treasurer to be promoted to the vice-presidency; highest National Bank references. Box 135, AMERICAN MACHINIST.

For Sale.

Big bargain in first-class, modern machine shop; send at once for full particulars. K., 526 5th st. South, Minneapolis, Minn.

For Sale—A going machine shop with large possibilities; been running many years; cause of sale, death in firm. W. D. Judson, New Haven, Conn.

I can sell your machine shop (or other business), with or without real estate, no matter where it is or what it is worth. Send description, state price and learn how. W. M. Ostrander, 111 North American Bldg., Philadelphia.

For Sale—United States patent No. 719,854, 1903, for best water gage in the world; now giving splendid results on English market; see description on page 788, December issue of POWER. Apply James Robinson, G. P. O. Leeds, England.

For Sale—A very desirable machine and repair shop, residence, location and business; manufacture wood-sawing machinery, which is in great demand; more business than can attend to; want to retire; a bargain. Irving Fox, Rochester, Minn.

For Sale—10 in. lathe patterns, drawings, jigs, templets, special tools and everything else necessary to manufacture the best 10 in. engine lathe on the market; no experiment; easy terms. Address The R. K. Le Blond Machine Tool Co., Cincinnati, O.

For Sale—A controlling interest in a small manufacturing and jobbing machine shop in growing city in southern Michigan; well-established business; a splendid chance for a young machinist ambitious to have a shop and business of his own. Address A. B. C., care AMERICAN MACHINIST.

For Sale—A large, special double-turret screw machine, built by the Garvin Machine Co., with adjustable, revolving chuck at middle of bed, having capacity of 6 in. diameter, and with power feed to both turret slides; turrets have three faces for tools; weight about 4,000 lbs. Box 139, AMER. MACHINIST.

New modern brick machine shop, centrally located in Philadelphia, size 40x100 ft., with clear story, lantern, gallery and traveling crane, fully equipped with new machine tools, having sold former business, is offered for sale or rent, or will combine with going concern requiring these facilities and some additional capital. Box 140, AMER. MACHINIST.

For Sale—Four Watts-Campbell Corliss engines, 24x56; 400 horse-power at 100 lbs. steam pressure; 70 revolutions per minute; flywheel—diameter 20 ft., face 46 in.; condition first class. One double Watts-Campbell Corliss engine, 18x42; 250 horse-power at same pressure; 91 revolutions per minute; flywheel—diameter 16 ft., face 32 in. One N. Y. Safety engine, 12x12; 75 horse-power at same pressure; 250 revolutions per minute, 2 belt wheels, 4½ ft.; diameter 17½ in. and 13 in. face. Will sell singly. Can be seen in New York city by addressing The United Electric Light & Power Company, 1170 Broadway, New York city.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona-fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

ILLINOIS.

A traveling tool and machinery man, age 32, A1 mechanic, wants position as purchasing agent in up-to-date company. Address "Economical," care AMERICAN MACHINIST.

Broadly qualified machine works general superintendent, desiring new location, invites confidential inquiries; state particulars. "Conservant," care AMERICAN MACHINIST.

Technical graduate, designer of jigs and fixtures, experience as assistant superintendent, desires position with large manufacturing concern for interchangeable work. Address Box 148, AMERICAN MACHINIST.

MASSACHUSETTS.

Position wanted by tool grinder; 6 years' experience on jig and tool work. Address T. G., care AMERICAN MACHINIST.

Mechanical draftsman and designer, with technical education, 10 years' experience in drawing room and shop, careful and rapid, 28 years old, desires position. S. S. W., care AMERICAN MACHINIST.

Position wanted by a mechanic in machine shop; jigs, tools, die maker or foreman for light machinery and hardware; harden and temper in quantities; is a hustler; gives up position January 1, 1905, as superintendent of a manufacturing concern for 15 years. Address P., care AMERICAN MACHINIST.

Practical draftsman and designer; American; 28; single; 3 years machinist and 2 years draftsman with Hendey Machine Co.; 2 years draftsman United Shoe Machy. Co.; 6 months draftsman Locomobile Co.; general designing with tools a specialty; position with future desired; references. Address W. E. Ingham, Room 722, Tremont Bldg., Boston, Mass.

MICHIGAN.

Designer, graduate M. E., age 29, 2 years shop, 8 years office, as designer, inspector, engineer on apparatus, electro-mechanical, special machinery, absolutely first-class, desires good opening. Box 122, AMER. MACH.

NEW JERSEY.

Practical mechanical draftsman wishes position. Box 151, AMERICAN MACHINIST.

First-class toolmaker and mechanic, experienced on jigs, tools and fixtures; capable to design and take charge, desires position. Box 137, AMERICAN MACHINIST.

Wanted—Position as superintendent of machine shops; first-class references; all-round, broad-gauge man; production to govern salary. Box 141, AMER. MACHINIST.

Position as machine shop foreman or assistant superintendent; can handle work and men advantageously; references tell all about it; age 40. Box 138, AMERICAN MACHINIST.

NEW YORK.

Draftsman, with long experience, seeks position. Box 149, AMERICAN MACHINIST.

First-class draftsman wants position. Address "Graduate," care AMERICAN MACHINIST.

Experienced mechanical draftsman, graduated, wants position. Address Box 143, A. M.

First-class mechanical draftsman wants to change position; New York, Brooklyn or vicinity preferred. O. N., Box 145, AM. M.

Wanted—Position as foreman with reliable concern; varied experience; can handle help profitably and is a thorough mechanic. Box 4, AMERICAN MACHINIST.

Position as foreman of small machine shop, by practical mechanic of long experience in machine and blacksmith shop; used to handling men. R. C. H., care AMER. MACHINIST.

Wanted—Position as traveling salesman for the introduction of machine tools; well acquainted with most of the machine shops and dealers in U. S. and Canada. Address "V.," care AMERICAN MACHINIST.

PENNSYLVANIA.

Mechanical draftsman, college graduate, wants position; 3 years' shop experience; 3½ years in drawing room. Box 136, AM. M.

Experienced mechanical draftsman, 34, wants position as designer; engineering and inventive work preferred. A. O. S. I., care AMERICAN MACHINIST.

Mechanical draftsman and designer, with 3 years' shop and 5 years' drawing-room experience, desires to change; graduated M. E. Box 142, AMERICAN MACHINIST.

Purchasing agent and head of cost department for high-speed engine concern is desirous of making a change and invites confidential inquiries. Address Box 134, AM. MACH.

Mechanical engineer, 14 years' experience, familiar with heavy machine tools, hydraulic machinery, cranes, structural work, etc., desires change; can fill leading position. Address Box 152, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—First-class polishers on gun work. Ross Rifle Co., Quebec, Canada.

Wanted—First-class toolmakers for fixtures and gauge work; applicants should state details of experience and wages wanted. Ross Rifle Co., Quebec, Canada.

ILLINOIS.

Draftsman, mechanical; detailers and designers of gas engines; permanent. Box 147, AMERICAN MACHINIST.

An old-established company wants general superintendent for light manufacturing plant; 200 employees; must have business and mechanical ability and be an all-round mechanic; please state experience, age, references and salary expected. Box 133, AMER. MACHINIST.

Wanted—Chief draftsman in drafting room employing from 5 to 12 men; must be accurate, capable of securing careful and rapid work from the men under him; experience in transmission machinery and in lighter structural work, together with familiarity with sheet metal work, is desirable. Address, with full particulars, Box 127, AMER. MACHINIST.

Wanted—Foreman machinist to take charge of a manufacturing department, employing about 60 hands, in one of the best cities in the Middle States; an educated man preferred; must be a good mechanic and have had experience in manufacturing special light work, such as sewing machines, gun work, or other similar product, where the most modern, up-to-date machinery, tools and methods were employed; must be a man of good character, capable of handling men and of producing good results; a permanent position for the right man; write full particulars in regard to age, experience, salary, etc. Address Box 112, AMERICAN MACHINIST.

INDIANA.

Wanted—First-class operators for large milling machines, also lathe and boring mill operators; good jobs for good men. Apply or write, Atlas Engine Works, Indianapolis, Ind.

Wanted—First-class toolmaker having had experience with large and small punches, dies, jigs, fixtures, etc.; must be capable of directing other workmen and do good work himself; the right man must be practical and conscientious and able to take advancement if qualified. State actual experience and qualification to Rogers, care AMER. MACH.

MASSACHUSETTS.

Wanted—First-class machine designer; $100 per month; position in Connecticut. Address Drawer "K," Holyoke, Mass.

Wanted—Experienced man on Gleason bevel gear planers. Address, giving particulars, "Gears," AMERICAN MACHINIST.

Wanted—Tool steel salesman for New England; good salary to right party; must be thoroughly familiar with the manufacture and use of small tools. Address Box 144, AMERICAN MACHINIST.

Wanted—A competent mechanical designing draftsman with experience on electrical apparatus; also one with experience on high-speed steam engines. Apply, stating age, education and experience, to Engineer in Charge of Drawing Office, General Elec. Co., West Lynn, Mass.

MICHIGAN.

Wanted—Factory superintendent; an experienced man in an extensive manufacturing plant in a desirable city in one of the middle States; must be accustomed to the latest and best machine shop methods and practices; a technical graduate preferred, provided he has had actual shop experience; to suit us he must be a broad-gauge man of character and ability; must know how to get results, and be capable of producing accurate, interchangeable work advantageously; please save correspondence by stating age, experience, list of references, salary wanted, etc. Address Box 92, AMERICAN MACHINIST.

NEW YORK.

Wanted—Man of practical experience in designing, manufacturing and operating gasoline engines, marine and stationary; management of department open to capable applicant; state age, experience and salary desired. Box 117, AMERICAN MACHINIST.

High-Class Opportunities.—Many changes are made around the first of the year. We know where these changes are. We desire, among other positions, sales manager, manufacturing, $2,000; mechanical engineer, $1,800; salesman, $1,500; bookkeeper, $1,200. Inquire Business Opportunity Company, 1 Union Square, New York.

Wanted—Foreman for machine department of large concern; young man familiar with engine and pump work preferred; must be up to date on methods and capable of getting out a high quality of work at a low cost; give full details of experience, present and past employers and salary expected. Box 150, AMERICAN MACHINIST.

OHIO.

Wanted—Man, with practical experience in manufacturing, to take charge of tools and production in factory. Address Box 68, AMERICAN MACHINIST.

Wanted—Foreman for machine shop manufacturing two-cycle gas engines and oil-country machinery, employing about 25 men; state experience and salary expected. Address Box 126, AMERICAN MACHINIST.

PENNSYLVANIA.

Machinists wanted; steady work and good wages for reliable men. Stoever Foundry & Manufacturing Co., Myerstown, Pa.

Foreman, machine shop; large engine company in East; write fully, giving references, salary, experience, etc. Box 146, AM. MACH.

Wanted—First-class designing draftsman, technical graduate, familiar with engine and compressor design; also two or three good patternmakers. Address Box 111, AM. M.

Our business is constantly increasing and we invite applications from machine and floor hands, accustomed to machine tool work. Standard Engineering Works, Ellwood City, Pa.

WEST OF MISSISSIPPI.

Elevator-erecting men wanted; give experience and wages. Kimball Brothers Co., Council Bluffs, Iowa.

Draftsman familiar with passenger elevators; good opportunity for man capable of working into executive position. Kimball Brothers Co., Council Bluffs, Iowa.

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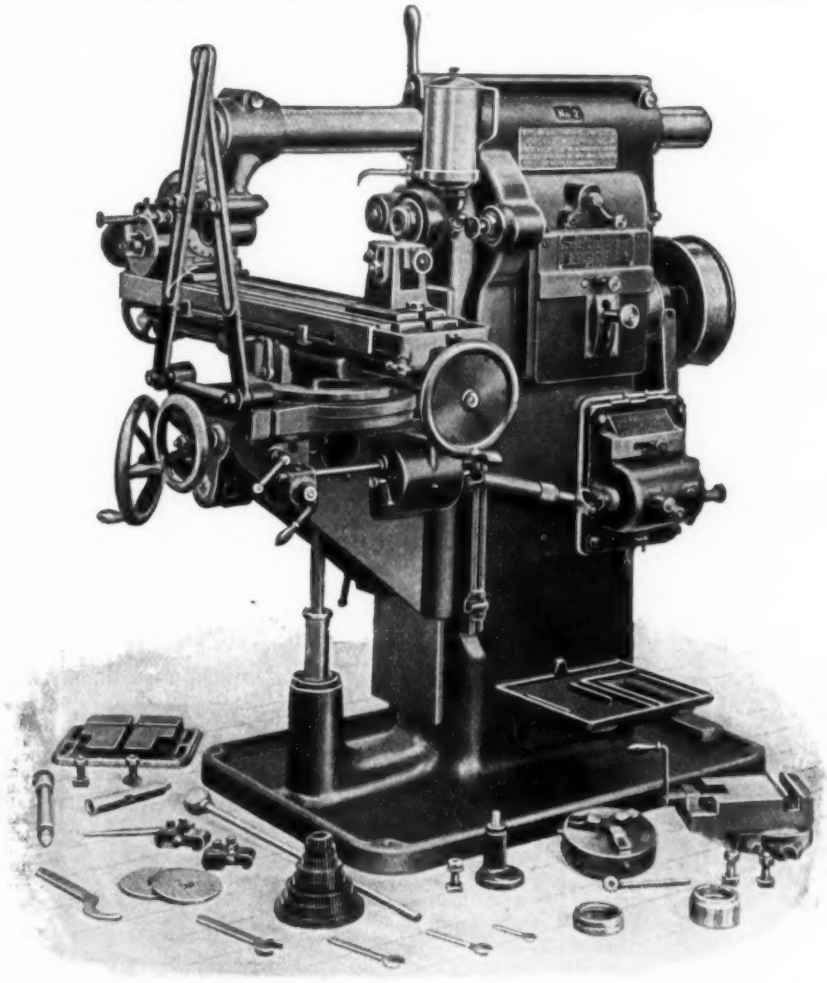

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Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Byram & Co., Detroit, Mich.
Northern Engr. Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cut Meters
Warner Instrument Co., Beloit, Wis.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Gay & Ward, Inc., Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Burr & Sons, Jno. T., Brooklyn, N. Y.
Davis Mach. Co., W. P., Rochester, N. Y.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.

Cutting-off Machines—*Cont'd*
Newton Mch. Tool Wks., Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Goodell Mfg. Co., Greenfield, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Western Tool & Mfg. Co., Springfield, O.

Diamond Tools
Dickinson, Thos. L., New York.
Osgood, J. L., Buffalo, N. Y.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Consolidated Press & Tool Co., Chicago, Ill.
Gem Mfg. Co., Pittsburg, Pa.
Lutter & Gies, Milwaukee, Wis.
Perkins Mach. Co., Warren, Mass.
Swaine Co., Fred J., St. Louis, Mo.
Zeh & Hahnemann, Newark, N. J.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Drill Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drawing Boards and Tables
Keuffel & Esser Co., New York.
Williams, Brown & Earle, Philadelphia, Pa.

Drawing Materials
Keuffel & Esser Co., New York.
Post Co., Frederick, New York.
Williams, Brown & Earle, Philadelphia, Pa.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Niles-Bement-Pond Co., New York.

Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Fenn-Sadler Mch. Co., Hartford, Conn.
Flather Planer Co., Mark, Nashua, N. H.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Moline Tool Co., Moline, Ill.
National Auto. Tool Co., Dayton, Ohio.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Norton & Jones Mch. Tool Wks., Plainville, Conn.
Prentiss Tool & Supply Co., New York.
Three Rivers Tool Co., Three Rivers, Mich.

Drilling Machines, Pneumatic
Allen, Jno. F., New York.
Chicago Pneu. Tool Co., Chicago, Ill.

Drilling Machines, Pneumatic—*Continued*
Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.
Phila. Pneumatic Tool Co., Philadelphia, Pa.
Rand Drill Co., New York.

Drilling Machines, Portable
Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mch. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cincin., O.
Fairbanks Co., New York.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Smith Co., Chas. G., Pittsburg, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blaisdell & Co., P., Worcester, Mass.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Dwight Slate Machine Co., Hartford, Conn.
Fairbanks Co., New York.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Knecht Bros. Co., Cincinnati, O.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mechanics Machine Co., Rockford, Ill.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Norton & Jones Mch. Tool Wks., Plainville, Conn.
Prentiss Tool & Supply Co., New York.
Sibley Machine Tool Co., South Bend, Ind.
Sloan & Chace Mfg. Co., Newark, N. J.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drills, Rail
Niles-Bement-Pond Co., New York.

Drills, Ratchet
Billings & Spencer Co., Hartford, Conn.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.

Drying Apparatus
American Blower Co., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Dust Collectors
Allington & Curtis Mfg. Co., Saginaw, Mich.

Dynamos
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro-Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Holtzer-Cabot Elec. Co., Brookline, Mass.
Jantz & Leist Elec. Co., Cin. O.
National Elec. Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Stanley Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincin., O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrical Supplies
American Elec. & Controller Co., New York.
Clark, Jr., & Co., Jas., Louisville, Ky.
Electric Controller & Supply Co., Cleveland, O.
Electro-Dynamic Co., Bayonne, N. J.
General Elec. Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Stanley Elec. Mfg. Co., Pittsfield, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery
American Tool Wks. Co., Cin., O.
Clark, Jr., & Co., Louisville, Ky.
Electric Controller & Supply Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cincin., O.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Morse, Williams & Co., Phila., Pa.

Emery Wheel Dressers
Desmond-Stephan Mfg. Co., Urbana, O.
Dickinson, Thos. L., New York.
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Heald Machine Co., Worcester, Mass.
International Specialty Co., Detroit, Mich.
Standard Tool Co., Cleveland, O.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

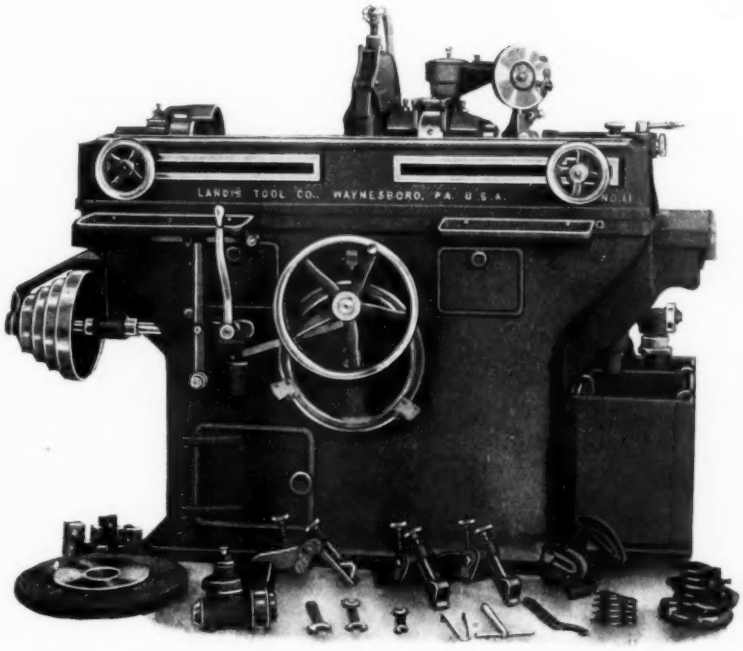
Engineers, Consulting and Mechanical
Dawson & Gray, New York.
Hollingsworth, Sam'l, Plainfield, N. J.

Engineers, Electrical
Crocker-Wheeler Co., Ampere, N. J.

Engines, Automobile
Franklin Mfg. Co., Syracuse, N. Y.
Olds Gasoline Engine Works, Lansing, Mich.
Tuttle Mfg. Co., H. A., So. Norwalk, Conn.

Engines, Gas and Gasoline
Backus Water Motor Co., Newark, N. J.
Foos Gas Eng. Co., Springfield, O.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Mathews, Hugh, Kansas City, Mo.
Mietz, August, New York.
New Era Gas Engine Co., Dayton, Ohio.

It is Very Important that You Get the Grinder Best Adapted to your Work



No. 11 LANDIS GRINDER, 8 in. Swing, 32 in. Between Centers.

A GRINDER may be a good one but it may not be a good one for you.

However, one of the LANDIS Grinders will surely meet your requirements. We make them in many styles.

For manufacturers who have many small parts to finish, the No. 11 Universal cannot be beaten. Considering the size of work it will take in, it is very heavy and rigid and will stand continuous severe service.

The emery wheel is large, spindle heavy, belt capacity abundant and water provision adequate.

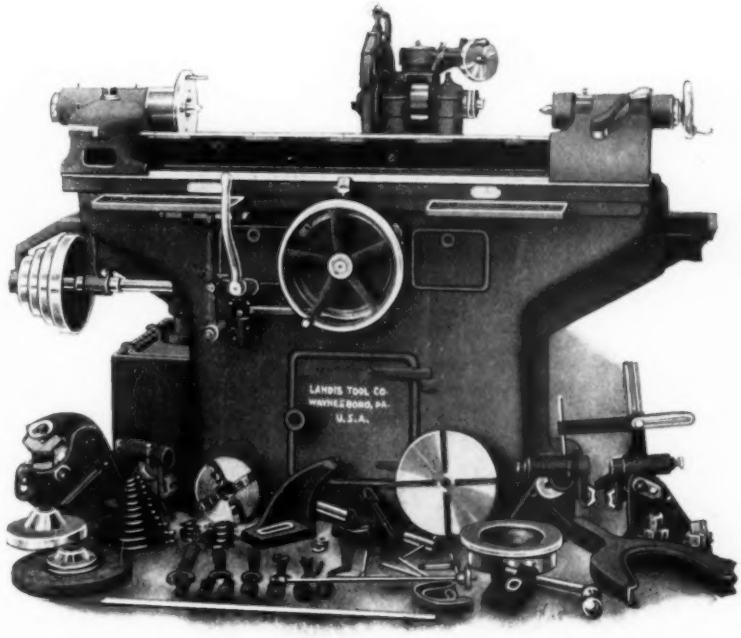
THE No. 3 Universal is a better grinder for tool work. At the same time it is an exceptionally good one for finishing small parts.

Neither of these two may be just the grinder you need.

If we knew your needs we could tell you which would be the most profitable style for you to buy.

Why not tell us your needs?

Send in for descriptions of the entire LANDIS line.



No. 3 LANDIS GRINDER, 12 in. Swing, 42 in. Between Centers.

Landis Tool Company, Waynesboro, Pa., U. S. A.

AGENTS: Walter H. Foster Co., 513 Williamson Building, Cleveland, Ohio. Walter H. Foster Co., 114 Liberty St., New York. C. W. Burton Griffiths & Co., London. Schuchardt & Schutte, Berlin, Cologne, Vienna, Brussels, Stockholm, St. Petersburg, Liege, Milano, Paris and Bilbao. A. R. Williams Machinery Co., Toronto. Williams & Wilson, Montreal, Canada.

Engines, Gas and Gasoline *Continued*
Olds Gasoline Engine Wks., Lansing, Mich.
Robertson Mfg. Co., Buffalo, N. Y.
Struthers-Wells Co., Warren, Pa.
Woolley Fdry. & Mach. Co., Anderson, Ind.

Engines, Oil
International Power Vehicle Co., Stamford, Conn.
Mietz, August, New York.

Engines, Steam
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Frick Co., Waynesboro, Pa.
Garden City Fan Co., Chicago, Ill.
Rand Drill Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads
Burt Mfg. Co., Akron, O.
Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition, Machinery
Philadelphia Bourse, Phila., Pa.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
American Blower Co., Detroit, Mich.
Garden City Fan Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

Files and Rasps
American Swiss File & Tool Co., New York.
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Montgomery & Co., New York.
Nicholson File Co., Provi., R. I.

File and Tool Holders
Bowers Mfg. Co., Geo. W., Boston, Mass.

Filing Machines
Cochrane Bly Mach. Wks., Rochester, N. Y.

Filler, Iron
Felton, Sibley & Co., Phila., Pa.
Smith Fdry. Supply Co., J. D., Cleveland, O.

Filters, Oil
Burt Mfg. Co., Akron, O.
Houghton & Co., E. F., Philadelphia, Pa.

Fire Extinguishers
Badger & Sons Co., E. B., Boston, Mass.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Stow Mfg. Co., Binghamton, N. Y.

Forges
Boynton & Plummer, Worcester, Mass.
Buffalo Forge Co., Buffalo, N. Y.
Ingersoll-Sergeant Drill Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Clapp Mfg. Co., E. D., Auburn, N. Y.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Wyman & Gordon, Worcester, Mass.

Forming Machines
Hartford Mch. Screw Co., Hartford, Conn.

Foundry Furnishings
Byram & Co., Detroit, Mich.
Gem Mfg. Co., Pittsburg, Pa.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Smith Fdry. Supply Co., J. D., Cleveland, O.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Furnaces, Electric
King, Hugh E., Chicago, Ill.
Pelton & Crane, Detroit, Mich.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gauges, Recording
Bristol Co., Waterbury, Conn.
Crosby Steam Gage & Valve Co., Boston, Mass.

Gauges, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gauges, Steam
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe M'g. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Dwight Slate Machine Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Mach. Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Mach. Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.

Gears, Cut —*Continued*
Horsburgh & Scott Co., The, Cleveland, O.
Messmer Mfg. Co., Ferd., St. Louis, Mo.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Wks., Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor, Wilson & Co., Allegheny, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Taylor, Wilson & Co., Allegheny, Pa.

Gears, Rawhide
Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mach. Co., Philadelphia, Pa.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor, Wilson & Co., Allegheny, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer & Co., S., Cincin., O.

Grinders, Center
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Smith Co., Chas. G., Pittsburg, Pa.

Grinders, Disk
Besly & Co., Chas. H., Chicago, Ill.
Diamond Mach. Co., Provi., R. I.
Heald Machine Co., Worcester, Mass.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.

Grinders, Drill
Heald Mch. Co., Worcester, Mass.
Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Portable
Heald Machine Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., W. F. & John, Rockford, Ill.

Grinders, Tool —*Continued*
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Provi., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Lutter & Gies, Milwaukee, Wis.
Niles-Bement-Pond Co., New York.
Northampton Emery Wheel Co., Leeds, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Grinding and Polishing Machines
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Montgomery & Co., New York.
Niles-Bement-Pond Co., New York.
Northampton Emery Wheel Co., Leeds, Mass.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett-Dock Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Smith Co., Chas. G., Pittsburg, Pa.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Walker Co., O. S., Worcester, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Adams Co., Dubuque, Iowa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
Houghton & Co., E. F., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northampton Emery Wheel Co., Leeds, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Scranton Whetstone & Abrasive Wheel Co., Scranton, Pa.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grindstones and Frames
Athol Machine Co., Athol, Mass.
Cleveland Stone Co., Cleveland, O.
Lombard & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.

Gun Barrel Machinery
Diamond Mach. Co., Prov., R. I.
Pratt & Whitney Co., Hartford, Conn.

Hack Saw Blades and Frames
Diamond Saw & Stamping Wks., Buffalo, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Millers Falls Co., New York.
Montgomery & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Test of Rough Gray-Iron Spur Gears.

BY W. M. WILSON.

It was the aim in the experiments, the results of which are given in this report, to determine the efficiency of rough gray-iron spur gears. The gears were tested under different conditions of speed and load with the purpose of determining the effect of these different conditions upon the efficiency. The gears were also tested with and without lubricant on the teeth in order to determine the advantage, if any, of lubrication under the conditions to which the surfaces of gear teeth are subjected.

The testing machine is shown in Fig. 1, and consists of the following parts: frame *M*, journals *F*, shafts *L* and *N*, yoke *H K H*, belt wheel *A*, brake wheel *B*, and gears *C* and *D*. The frame *M* is of pine timbers 5x5 inches, mortised into the posts at the corners. The journals *F* are firmly bolted to the wooden blocks *E* and the latter are clamped to the frame by means of the yokes *H K H*. Each of these yokes consists of two gray-iron straps *H* and *H* connected at each end by means of bolts one of which is shown at *K*. By loosening the nuts on these bolts the blocks *E* carrying the bearings can be moved on the frame so as to permit of any desired adjustment of the distance between centers of the shafts so as to accommodate the machine to gears of different sizes. The gears were fastened to the shafts by means of keys.

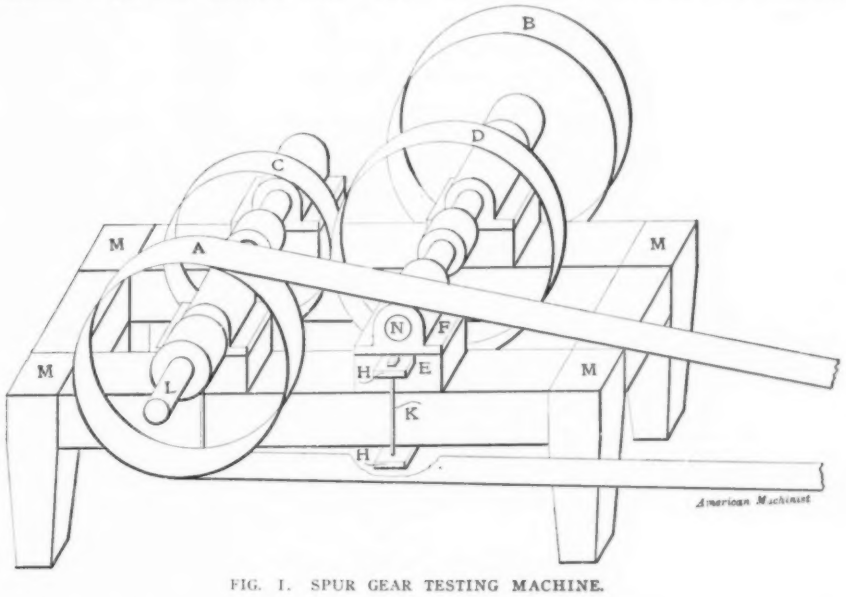


FIG. 1. SPUR GEAR TESTING MACHINE.

An electric motor was used to drive the gears and was also used as a transmission dynamometer.

The manner of conducting the tests was as follows: The brake wheel *B* was put on at *L* and an ordinary prony brake was fitted to it. The shaft *L* was moved back so that the gear *D* did not engage the gear *C*. The load to be carried by the motor was decided upon beforehand and the motor run at that load until the armature windings assumed a constant temperature. Usually about an hour was allowed for this operation. After the motor had been thoroughly warmed, a run was made to determine the combined efficiency of the motor, belt, and shaft *L*. This was done in the following manner: Electric readings, volts and amperes were taken every half minute for a period of two minutes and the electric energy furnished the motor determined from the average of these five readings. During the same two minutes the total number of revolutions of the shaft *L* was noted and the brake load was kept constant and this constant load noted. With the length of the brake arm known, the amount of power absorbed by the brake can be determined. The power absorbed by the brake divided by the power furnished the motor gives the combined efficiency of the motor, belt, and shaft *L*. A water rheostat was connected in series with the motor and by changing the resistance of this rheostat the speed of the motor could be changed at will. A series of runs was made and the motor calibrated thru a considerable range of speeds. With the motor used the current was constant for a given torque and the voltage varied with the speed so that a calibration curve could be drawn for a given torque upon the motor in which the ordinates represent efficiencies and the abscissas represent voltage. Such a curve is shown in Fig. 2, which is the calibration curve for the motor when it was drawing 12.3 amperes of current. As the efficiency of a belt varies with the humidity of the atmosphere, it was thought best to calibrate the motor each day the tests were being carried on.

The length of the brake arm was measured and from it the horse-power constant was determined and found to be .000819, so that the formula for brake horse-power is H. P. = .000819 × R. P. M. × brake load in pounds. The weight of the arm and pedestal has to be subtracted from the total scale reading to get the brake load. To determine the combined weight of these the following method was used: The brake was loosened and water poured on the brake wheel to reduce the friction of the brake as much as possible. First the motor was run with the belt crossed and

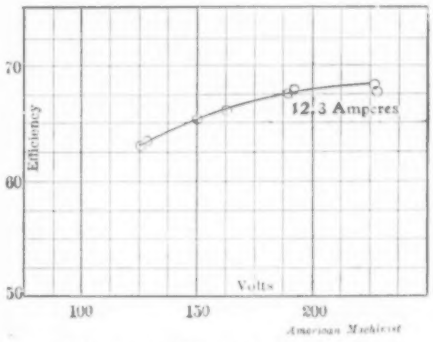


FIG. 2. CALIBRATION OF MOTOR.

the scale reading taken; then the motor was run with the belt straight, so that the brake-wheel ran in the opposite direction and the scale reading was again noted. The difference between the two scale readings equals twice the scale reading corresponding to the friction of the brake wheel. Half of this difference added to the lesser or subtracted from the greater reading gives the weight of the pedestal and arm.

After calibrating the motor the brake wheel was removed from *L* and put on *N* and the gear *D* moved so as to mesh with *C*. After these changes had been made, readings were taken in the same manner as when calibrating the motor. The efficiency of the motor, belt, two shafts, and gears equals the brake horse-power divided by the electric horse-power. This efficiency divided by the combined efficiency of the motor, belt, and one shaft gives the efficiency of the gears.

The results of the tests are given in the following tables and curves which are in themselves complete and need no explanation.

By calibrating the motor in the manner described, all losses of power between the poles of the motor and the brake are eliminated except the loss due to the meshing of the teeth and the loss due to journal friction for the shaft of the driven gear. This, it seems to the writer, gives the real efficiency of transmission, as the important question in the transmission of power is the ratio of the power taken from one shaft to that furnished the other. This is the ratio given as efficiency in the tables and curves.

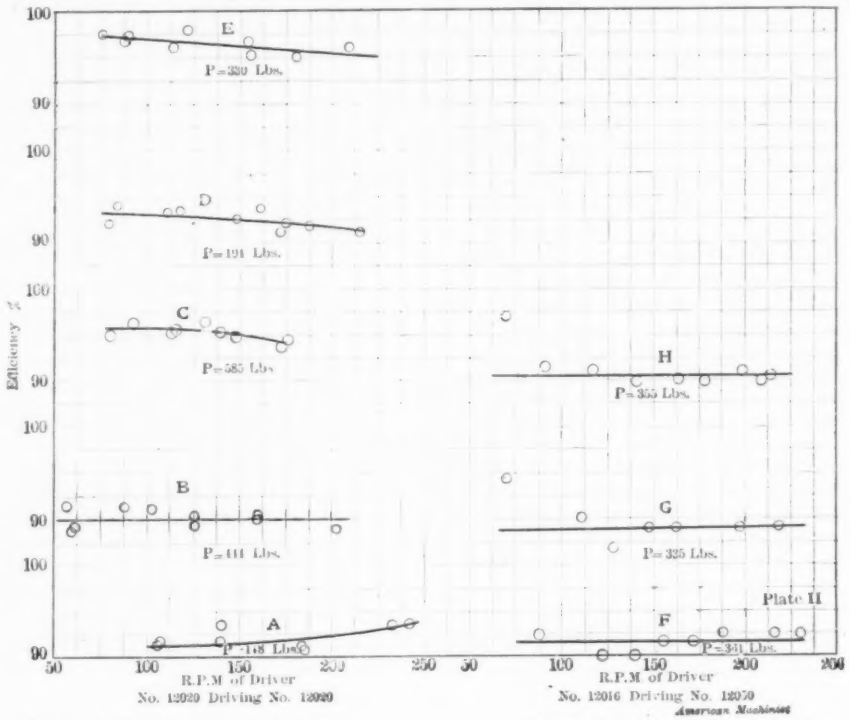
This report covers tests of two pairs of gears. One pair consists of two No. 12,020 gears having 20 teeth of 1½-inch circular pitch. The other pair consists of one No. 12,016 gear having 16 teeth of 1½-inch circular pitch, and one No. 12,050 gear having 50 teeth of 1½-inch circular pitch.

The details of the design of the first-named pair of gears are not known to me, but, judging from the appearances of the teeth, they had been laid out according to some empirical method such as is in general use in commercial manufacture of gray-iron gears, and were intended to approximate involutes. The second pair of gears was designed by me for a special service where the distance between centers had to be varied to meet the different conditions under which the machine which they were driving had to run. The tooth outlines are involute curves having an angle of obliquity of 22½ degrees when the distance between the centers of the gears is normal. The patterns were laid out from curves developed by kinematics. (For full description of gears see AMERICAN MACHINIST, Vol. 26, page 1712.) The normal distance between centers was to have been 15.80 inches, the least distance 15.50 inches, and the greatest distance 16 inches, but due to the fact that the shrinkage was less than was expected these dimensions are each .20 inch greater than what the design called for. When the gears are at the greatest distance between centers the angle of obliquity is 24¼ degrees, and when at the least distance this angle is 19½ degrees.

In Fig. 3 curves *A*, *B* and *C* give the results of tests of gears Nos. 12,020 and 12,020 running together without lubrication, and the average of all such tests gives an efficiency of 92.5 per cent. Curves *D* and *E* give the results of tests of the same gears under the same general conditions, except for the fact that in the case of these latter tests the gears were lubricated. The average of these tests gives an efficiency of 94.2 per cent., indicating that the use of a lubricant increased the efficiency 1.7 per cent. A greater gain from the use of a lubricant is obtained from the increase of the life of gears resulting from its use. In the case in which no lubricant was used, the gears wore very rapidly, while in the case in which the gears were lubricated there was not enough wear during the time of the tests to be noted.

After the tests had been completed an effort was made to eliminate the loss due to friction in the journals of the shaft of the driven gear. Several quantities had to be taken into account in this elimination which could not be determined accurately, so that the results offer only an estimate and not an exact determination. The fact that the brake wheel was on shaft *L* when the motor was calibrated does away with any correction which might otherwise be necessary because of its weight acting on the shaft *N* while the gears were tested.

In the case of gear No. 12,020 driving No. 12,020, the shaft of the driven gear was of wrought iron, 3 15-16 inches in diameter, and ran in a babbitt journal. The weight of the gear and shaft was 160 pounds, and in the case of the tests reported in the two left-hand columns of Table 1, the downward tangential force at the gear teeth was 194 pounds and the horizontal force 50 pounds. The total pressure on the journal, aside from that due to the brake wheel, was the resultant of three forces given above, or approximately 360 pounds. The coefficient of friction for the shaft and journal was taken as .03, which is not much in error for the given surfaces and the given conditions of pressure and velocity of rubbing. This gives a force due to friction of .03 × 360 = 10.8 pounds, acting at the surface of the shaft, which is equivalent to a force of 4.35 pounds applied at the pitch circle. Eliminating this loss and working from the data given in the two



Tests *A*, *B*, *C* without lubrication. Tests *F*, *G*, *H* with lubrication.
Tests *D*, *E* with lubrication.
P = tangential driving force at pitch line.

FIG. 3. RESULTS OF TESTS.

GEARS LUBRICATED.

Tangential force at pitch circle, 194 lbs.		Tangential force at pitch circle, 330 lbs.		Tangential force at pitch circle, 585 lbs.	
R. P. M.	Efficiency, %	R. P. M.	Efficiency, %	R. P. M.	Efficiency, %
80	92.00	76	97.33	81	94.97
84	94.05	89	96.66	92	96.10
119	93.55	123	97.75	113	95.28
112	93.31	115	95.99	114	95.45
162	93.60	150	96.27	132	96.28
149	92.57	155	96.57	140	95.29
187	91.56	182	95.81	149	94.81
172	91.08	181	95.05	177	94.57
177	92.04	209	96.16	173	93.87
215	91.36	192	95.50	Av.	95.20
215	91.19	157	95.18		
Av.	91.00	92	97.03		
		Av.	96.30		
Efficiency of Gears alone, 92.60%.		Efficiency of Gears alone, 98.00%.		Efficiency of Gears alone, 96.80%.	

GEARS NOT LUBRICATED.

Tangential force at pitch circle, 444 lbs.		Tangential force at pitch circle, 148 lbs.	
R. P. M.	Efficiency, %	R. P. M.	Efficiency, %
59	88.58	105	91.40
56	91.40	106	91.50
62	89.17	129	91.80
88	91.18	129	93.50
102	91.03	165	91.00
126	90.21	167	90.80
126	89.29	233	93.30
159	90.60	241	93.50
159	89.94		Av. 92.10
202	88.72		
	Av. 90.00		
Efficiency of Gears alone, 91.50%.		Efficiency of Gears alone, 94.80%.	

TABLE 1. NO. 12020 DRIVING 12020—STANDARD INVOLUTES.

left-hand columns of Table 1, the average efficiency of the gears under the conditions of the test is 92.6 per cent. In this way the efficiency of the gears was calculated for each of the different conditions under which the gears were tested, and the results are given in the tables.

Gears 12,016 and 12,050 ran together much more quietly than gears No. 12,020, but the former pair of gears had not been used as much before the test was made as had the latter, and the surfaces were not quite as smooth. This accounts for the difference in the efficiencies of the two pairs of gears.

The results of the tests indicate that:

1. The efficiency of rough gray-iron spur gears is independent of the speed of the gears within the range covered in this report.

2. There is no indication from the limited number of tests that the amount of power transmitted affects the efficiency to any great extent.

3. The use of a heavy grease on the teeth increases the efficiency slightly (average from tests, 1.7 per cent.).

4. Under ordinary conditions gears of medium size running at from 60 to 230 revolutions per minute have an efficiency of from 90 to 95 per cent.

GEARS LUBRICATED.

22½ degree involutes. 16″ between centers. Tangential force at pitch line, 361 lbs.		24¼ degree involutes. 16.2″ between centers. Tangential force at pitch line, 355 lbs.		19½ degree involutes. 15.7″ between centers. Tangential force at pitch line, 353 lbs.	
R. P. M.	Efficiency, %	R. P. M.	Efficiency, %	R. P. M.	Efficiency, %
88	92.40	116	91 00	110	90 00
123	90.00	68	96 90	69	94 40
140	89.90	90	91.50	127	86 80
156	91.30	140	89 90	147	88 90
172	91.30	163	90.10	162	88.80
188	92.30	177	90.00	196	88 90
216	92 30	197	90.90	218	89 20
229	92.40	208	90 00		
	Av. 91.50	214	90.30		Av. 89.60
			Av. 91 20		
Efficiency of Gears alone, 92.30%.		Efficiency of Gears alone, 92 10%.		Efficiency of Gears alone, 90.50%.	

TABLE 2. NO. 12016 DRIVING 12050.

It is announced that the locomotive testing plant of the Pennsylvania Railroad, which was such a magnificent engineering exhibit at St. Louis and which was described and illustrated in our pages (1661 and following, Vol. 27), is to be permanently installed at Altoona, Pa., under the direction of Special Agent F. D. Cassanave. The plant will become a permanent feature of the company's equipment and will be operated in connection with the chemical and physical laboratory to be established in the near future. The results and records obtained will be of value not only to the Pennsylvania system, but to the entire engineering world. The establishment of the plant illustrates and enforces the modern way of knowing what is best to do before it is done, rather than constantly correcting costly mistakes.

Echoes From the Oil Country — A Visit to the Baldwin Locomotive Works.

I never owned a locomotive. I never ran a locomotive. I never worked in a locomotive shop. I don't even own stock in a railroad. Why should I bother people who do make locomotives and make them to sell?

Well, now, I have seen locomotives, and surely I have read many, many times about how they are made "two complete locomotives in a day. Think of the modern miracle that this is, etc.," as the daily paper tells it.

If the Baldwin Locomotive Works don't want to be bothered with visitors they should be less conspicuous. I try to think of something of interest to visit in Philadelphia and that seems to be the only definite place in my mind and I will go there. I never saw any account of how they treat sight-seeing visitors and I can at least learn how now.

I did feel a little like an intruder as I walked up the steps and into the busy office, where everyone seemed to have just a little bit too much on hand at that particular time, altho it was a nice, polite young man who responded to the card and message I sent in.

"I understand that you wish to go into and see the works?"

"Yes, I did not know if you would permit it, but would like very much to see how you do things."

"We do not have any regular system of putting visitors thru, but if you are enough acquainted with shop methods to feel able to get around alone we might ——."

"If you are willing to let me in, I am willing to take care of myself. Only let me in."

Soon I was in possession of a pass, by accepting which I agreed not to talk to the workmen and not to call the company to account for soiled clothing or personal injury. I never did think I would be good material for a machine to work on, nor be much of a shortstop in case a crane dropped its load, anyhow, even without the pass.

"Get into the elevator and"——. In about four seconds I was down below and the elevator was gone and unless someone headed me off I was free to go where I chose. If it is anyone's business there to head off folks I missed him, for evidently the men all knew how the passes read and did not tempt me by speaking to me.

BOILER SHOP NOISES.

What did I see, do you ask? When I got as far as into the boiler shop—perhaps it was *a* boiler shop, for there may have been more; I don't pretend to say, as I was not *all* thru the works—I had become so interested in what I was seeing that the noise did not impress me until I stopped and particularly listened for it. It may seem rather strange to some, but I expected noise and so it did not attract my attention. If I had walked into that shop and had *not* heard a noise I can assure you that it would have attracted my attention very suddenly. I only thought of the noise as I did because of having heard a man say it was the noisiest place he was ever in. I do not have a distinct recollection of having heard any noise in any other part of the works that was enough different from what would be natural to the place to leave a lasting impression.

I did get a few impressions, and one of the first was that a small bundle of broom corn, perhaps 1½ inches in diameter seemed to be the most generally used means of brushing up chips and keeping the machines clean. This bundle was bound around in several places, and as it wore down it was only necessary to take off a binding and so continue until all was used up but a stub. A new one seemed about as long as the corn end of a new broom.

NO WASTE.

The next thing that impressed me was that I *didn't* see any waste. I had been roaming around for some time before it struck me that I had not seen any, and after that I looked for some when something else didn't make me forget it. I am not going to say that they do not use any, but if it had been kicked around as it is in some places I should surely have seen it. I was in on Monday, and perhaps everything was so clean from Saturday that waste was not yet needed.

I have heard a lot about how much better it is to throw away old tools than to use them, but evidently the missionaries have failed to do their duty in this place. If the work crowded it looks as if instead of throwing away the old machine they got a most modern one and set beside it. I have a suspicion that in some cases it hurried the new one to beat the old one enough to be noticeable. I know that this may be considered almost treason by some of my friends, but if it is, please blame it on the Baldwin shops and not on me. They shouldn't let their machines look that way if it isn't so.

One other very original way they have. Not having a map of the various rooms,

nor a guide, I did not travel systematically from one department to another, but I am convinced that each department was figured out by and for itself. Some of the stories are high and some are not. It is much as if each department was made and just set down where there was room. Sometimes it was on top of another one, sometimes beside it and sometimes across the end of it. The floor levels do not match, and I am sure I would not envy a man the job of running all those various line shafts from a central station if he had to use belt drives all thru.

I believe they make some money, because I saw they evidently had been putting on a piece to the building here and there, but still keeping the old that they had.

OLD MACHINES.

I feel confident that some of the machines I saw were built before I was born, and my friends all know that was quite a while ago, and I am glad to see that being honest machines there is still profitable work found for them to do; not perhaps the same work the newer ones are doing, but still necessary work, and it sets at rest the fear so often expressed that after a man is old he will be crowded out. Evidently, he will not be if he is willing and honest.

In corroboration of this I will say that since that I have come across a machinist and a patternmaker who have been forty-nine years in one shop and are still there. The shop has changed hands a number of times, but they have stayed with it and appear happy.

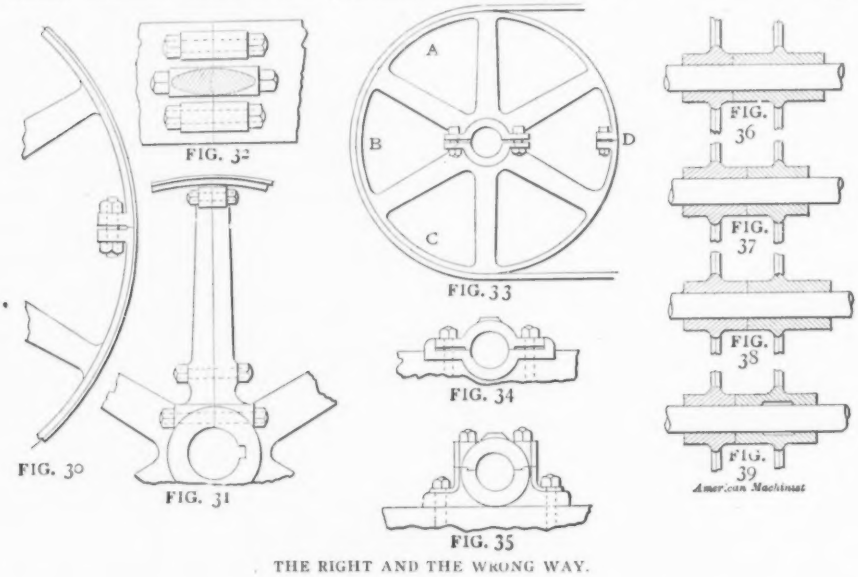
Electric motors seem to fit in very naturally to shops made as these are, and I have no doubt everything is much more systematically arranged than a stranger in for the first time might think. I am sure that I saw a fine lot of workmen among other things and often nearly forgot the wording of the pass. Had I talked to them I might have seen more clearly.

W. OSBORNE.

Things That are Usually Wrong—VI.

BY JOHN E. SWEET.

If one were to try and find the worst place to part the rim of a split pulley, so far as resisting centrifugal force is concerned, he would find it just where they are usually parted—half way between the arms. There is in this case not only the additional weight of lugs and bolts, adding to the centrifugal force, but the grip of the bolts which, when made as usual, Fig. 30, tend to throw out the rim at this point. If parted as in Figs. 31 and 32 and the joint is made as strong as the rim in other parts, the split pulley will, except for the weight of lugs and bolts, stand the same speed as a solid one. There is a third strain seldom considered—the pull of a heavy belt which tends to bend in the rim between the arms on those sections where the belt laps the pulley as at *A B C*, Fig. 33—an action which tends to throw out that part of the rim where there is no belt as at *D*, so that in addition to the weight of the lugs and bolts and the strain of the bolts, there is this third strain, which may be the greatest of the three. With the joint thru the center of the arm weakness, so far as the parting is concerned, is pretty well avoided.



THE RIGHT AND THE WRONG WAY.

In some cases there was at the start a reason that justified making things in a certain way, which, later, did not obtain, and yet the old way was continued, many times because the old patterns continued in use, but more often because of the habit of doing things as they had been done before. A fair example of this is shown in Fig. 33. Why the joints in the early split pulley hubs were made in this way may have been because that was the way parted boxes were made to bolt to wood framing, Fig. 34, or it may have been that the bolts were the costly part of the job, and the thin flanges called for short bolts, or it may have been a cheap way to make the pattern. Anyway this form of securing the two parts of boxes and pulleys died hard, with good examples, as shown in Fig. 35, in sight. The wrong sort stayed by the New England mechanics long after the right was common in Philadelphia. And it was the same with the tailstock of the lathe. It seems as if the most of the New England builders never would have given up the original tailstock, which had everything possible wrong about it, if it had not been for the foreign demand, forcing them to change to the better way.

There are at least three wrong ways and one right one to arrange tight and loose countershaft pulleys: Fig. 36 is right, Fig. 37 is bad and very common, Fig. 38 worse, and Fig. 39 worse yet, if possible. Too little wearing surface in one, the next is sure to wear the hole bell muzzle and the shaft tapering and oil gums up in the chamber of the last and absorbs the next charge of oil so that none gets to the bearings. A chambered pulley or gear of any sort is worse than a good continuous fit. There is never too much bearing surface for any wheel that needs to be put on to stay.

The Business Engineer.

Not long ago a popular magazine called attention to the "business engineer." That is, it implied that the man who is to conduct a business requires as rigid a technical training and stands on as high an intellectual plane as the man who constructs a bridge.

By a curious and most significant coincidence the University of Brussels, at just about the same time, announced that it would bestow the title of "business engineer" upon the graduates of its newly-established department of commercial studies.

Meanwhile, commercial education has raised its head almost simultaneously in the three great commercial countries of the world. Germany has three new "commercial universities," at Frankfort, Leipsic and Cologne—a fourth is about to open in Berlin. In England, the universities of London and Manchester have added commercial courses to their curricula, and the University of Birmingham has established a "faculty of commerce."

It has, however, been left to Professor Waxmeiler, of the University of Brussels, to take up the matter of commercial education in the most practical form, and he has gathered together from the most progressive countries a perfect museum of office and shop appliances so as to be able, not only to give their students theoretical training, but practical knowledge of the appliances to be used. Costing systems, for example, are illustrated by the actual process employed in some of the larger American houses secured by M. George de Leeney on a recent visit to the States. The student is not only told how the work is done but is taught how to do it. Large charts showing costing systems hang on the walls, and from these examples the

student is taught the use of the card systems. Time clocks and lapsed time clocks are there which the students are taught to use. Filing systems are there, card index systems, loose leaf ledgers and binders, and all the modern office appliances. Fisher Billing Machines are demonstrated and students taught the application of the machine to order and invoice work. Forms used by firms are exhibited to illustrate the method of planning compound or Fisherized forms, whereby the entry of the order is combined with the making of the invoice and Sales Book entry. The use of the adding and calculating machine is also taught, and, indeed, every appliance the student is likely to have to use in modern offices.

It is Professor Waxmeiler's conviction that, during the twentieth century, the process of distributing manufactured goods thru the markets of the world will become so complicated a profession, demanding so intimate an acquaintance with labor and time saving devices, with methods of transportation, and with the habits and customs of the people of the various countries that, in the first place, rigid preliminary training will be required, and that, in the second place, the business man will be set off in a professional technical class by himself, just as much as the civil engineer, the architect, the chemist, or the physician.—*Method.*

Pennsylvania makes more than half the iron produced in the United States and mines less than 2 per cent. of the iron ore.

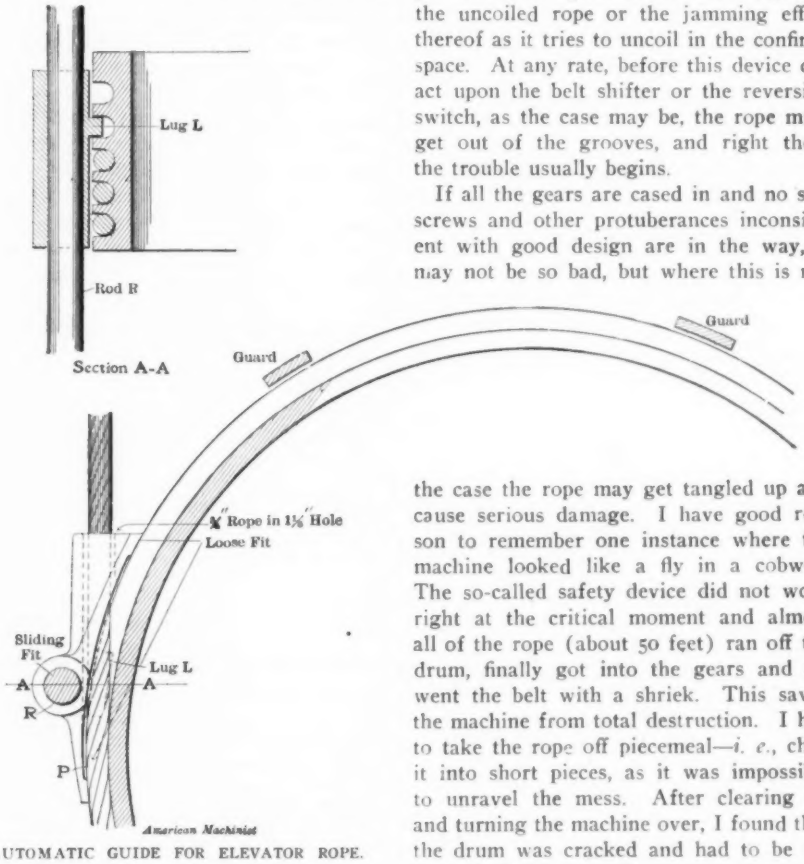
Automatic Guide for Elevator Rope.

BY L. E. VATOR.

Anyone who has been entrusted with the care of an elevator machine of the drum type is more or less familiar with the fact that some of these harmless-looking machines—after years of good behavior—may refuse service at times. Almost all of these machines are provided with a safety device—more or less efficient—for immediate stopping in case the hoisting rope gets slack from any cause.

One kind of these "slack cable stops," as they are called, consists of a fender or apron, hanging below the drum in close proximity to the rope. It is hinged about an axis parallel to the drum shaft and depends for its operation on the weight of the uncoiled rope or the jamming effect thereof as it tries to uncoil in the confined space. At any rate, before this device can act upon the belt shifter or the reversing switch, as the case may be, the rope must get out of the grooves, and right there the trouble usually begins.

If all the gears are cased in and no setscrews and other protuberances inconsistent with good design are in the way, it may not be so bad, but where this is not the case the rope may get tangled up and cause serious damage. I have good reason to remember one instance where the machine looked like a fly in a cobweb. The so-called safety device did not work right at the critical moment and almost all of the rope (about 50 feet) ran off the drum, finally got into the gears and off went the belt with a shriek. This saved the machine from total destruction. I had to take the rope off piecemeal—*i. e.*, chop it into short pieces, as it was impossible to unravel the mess. After clearing up and turning the machine over, I found that the drum was cracked and had to be renewed. It was thought to be more economical to make a decent job of it rather than to patch it up, so the Old Man for once allowed himself to be persuaded to set aside his "dollars and cents" argument in preference to taking any more chances on another smash-up.



AUTOMATIC GUIDE FOR ELEVATOR ROPE.

We changed a suitable drum pattern by lagging it up, so as to permit the cutting of a groove 13-16 inch deep, the rope being ¼ inch in diameter. Thus the rope was entirely below the surface of the drum. To keep it from jumping out, some guards were put across the face of it, with about ⅛ inch clearance. To make absolutely sure of the rope finding the proper groove, where it winds on to the drum, we put in a fair-leader, which has given entire satisfaction. It is automatic in its action, and if properly made will cause no wear on the rope, as the latter does not touch it normally.

Referring to the figure, *R* is a 1¼-inch rod on which the fair-leader slides back and forth as the rope winds and unwinds. It has a slight clearance at points *P*. The chipping strip is wide enough to overlap several grooves, so that there is no danger of hooking on to the drum at these places. The hole thru which the rope runs registers with a groove and the lug *L* with the one next to it. By this lug the fair-leader is taken along about the same way as the nut on a screw. The adoption of this scheme necessitated the discarding of the apron type of slack cable stop and in its place we put the equally simple, but more certain traveling sheave. This device is much more sensitive and reliable and is used almost entirely nowadays.

It consists usually of a light idler sheave about 4 inches in diameter. It is pressed against the taut hoisting rope by a weighted lever and is free to turn on a small shaft and travel sideways as well. This shaft is capable of rocking at right angles to its axis and is supported by two rocker arms. If the rope deflects ever so little, the sheave keeps right up to it. It transmits its rocking motion to a clutch, which engages with the automatic stop for the top and bottom landing and this in turn immediately shifts the belt or reverses the switch on a motor-driven machine.

In conclusion, I would mention that the accident previously referred to was caused by the racing of the main engine. This luckily lasted but a few moments, but happened just while the elevator was descending. The undue acceleration tripped the safety catch on the elevator car and the latter promptly stuck fast between two floors. The winding machine for some reason did not respond so quickly, but kept on going until the belt was thrown off.

A Matrimonial Scheme.

A common source of friction, especially in large establishments, is to be found in the occasional subscriptions taken up in order to give presents to persons entering matrimony or leaving for other fields of labor. The head of a large manufacturing firm in Toronto was recently induced to inspect a list which had been gotten up among his employees and he found that some of them had given more than he thought they could afford. He then determined to change the system and had a box made into which when any subscriptions were taken up among the employees they could drop their contributions without anyone knowing the amounts given. He says that the aggregate of the contributions decreased, but he is confident that his employees now give, when occasion demands it, just what they can afford to give. The scheme is a simple one and could no doubt be adopted to advantage by many other firms, and the old system, which is practically a system of blackmail in many cases, could be obviated.—*Hardware and Metal.*

The Development and Use of High-Speed Tool Steel—III.* Appendix.

BY J. M. GLEDHILL.

The following results with "A. W." high-speed steel, the analysis of which has been given, will be of interest:

BY SIR W. G. ARMSTRONG, WHITWORTH & CO.

Armor-plate bolts shown in Fig. 10. Cutting speed, 160 feet per minute; mean depth of cut, ¾ inch; traverse, 1-32 inch; reduction in weight, 62 pounds. Forty bolts turned in one day with "A. W." high-speed tool steel. Sectioned area indicates the metal removed. Total weight of metal removed in 10 hours, 2,480 pounds.

Sleeves for armor-plate bolts shown in Fig. 11. Cutting speed, 160 feet per minute; maximum depth cut, 1⅛ inches; traverse, 1-32 inch; reduction in weight, 36 pounds. Sixty sleeves produced per day of 10 hours in 12-inch high-speed lathe using "A. W." steel. Sectioned area indicates the metal removed from each blank. Total weight of metal removed in 10 hours, 2,160 pounds.

[The lathe on which this work was done together with a day's work both rough and finished has been shown in Fig. 6.—Ed.]

Sleeves for armor-plate bolts shown in Fig. 12. Cutting speed, 150 feet per minute; maximum depth of cut, ¾ inch; reduction in weight, 8.37 pounds. Ninety sleeves produced per day of 10 hours with "A. W." high-speed milling cutter. Sectioned area indicates the metal removed from each blank. Total weight of metal removed in 10 hours, 754 pounds.

Hexagon nuts for armor-plate bolts shown in Fig. 13. Speed of cutter, 150 feet per minute; maximum depth of cut, 17-32 inch; reduction in weight, 7½ pounds. Ninety sleeves produced per day of 10 hours with milling cutter made of "A. W." steel. Sectioned area indicates metal removed. Total weight of metal removed in 10 hours, 675 pounds.

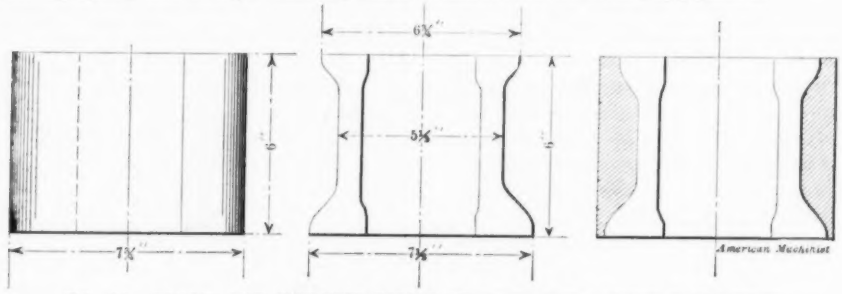


FIG. 11. ROUGH AND FINISHED FORMS OF SLEEVES FOR ARMOR PLATE BOLTS.

[The milling machine on which this work was done together with one day's work both rough and finished has been shown in Fig. 7.—Ed.]

The remaining results of the latest workshop practise have been kindly supplied by various engineering firms in Great Britain; and will give some idea of the great advancement in cutting speeds since the introduction of the steel.

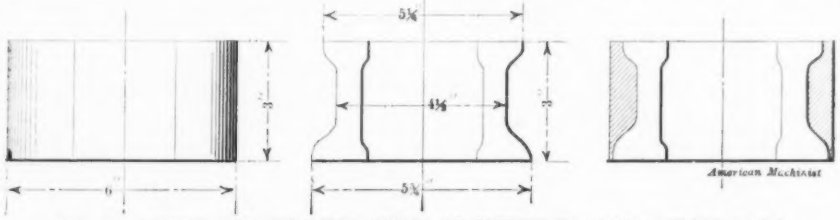


FIG. 12. ROUGH AND FINISHED FORMS OF SLEEVES FOR ARMOR PLATE BOLTS.

[The next series of results by Alfred Herbert & Co. have already been published by us at page 789. The following results are from eight different firms as indicated by the rules.—Ed.]

GENERAL SHOP WORK.

"Much of the work dealt with, especially the gray-iron work, is quite light and will not stand very heavy cuts, and up to the present it has not been possible to install special machinery for heavy cutting with high-speed steel to any great extent. It will be seen, however, that the figures given represent a very good duty on the part of the cutting steel."

Rough Turning Mild Steel Bars with high-speed steel on No. 5 hexagon turret lathe. Bars, 4½ inches diameter; turning, 31½ feet per minute; depth of cut, ¼ inch; feed, ¼ inch. The above is the result of a test. In actual practise higher cutting speeds and finer feeds are used, as the bar is not supported and will not stand these very heavy cuts when projecting very far from the chuck. The tool was lubricated with a liberal supply of lard oil.

Rough Turning Capstan Lathe Spindles with high-speed steel on 12-inch lathe. Cutting speed, 58 feet per minute; depth of cut, ⅜ inch; feed, 16 cuts per inch.

The above spindles are made of steel containing 0.5 per cent. carbon. The tool was lubricated with a liberal supply of suds. The limit of the work in this case was the lathe and not the tool. At another test the same work was done at 63 feet per minute. Cut, ⅜ inch deep; feed, 32 cuts per inch.

Boring Lathe Spindles out of the solid bar with high-speed flat cutter. The material from which these spindles are made contains 0.5 per cent. carbon. Diameter of holes, 3 9-16 inches. Bored out of the solid at 64 turns per minute = 60 feet per minute. Feed, 85 cuts per inch, 45 inches travel per hour.

Pulley Turning with high-speed steel tools. Roughing out, 60 feet per minute; cut, 3-32 inch deep; feed, 3-32 inch per revolution; finishing cut, 100 feet per minute; cut, 1-32 inch deep; feed, 36 cuts per inch.

The pulleys in question are very thin, and will not stand a heavy cut.

MILLING.

Milling Medium Gray Iron with face-milling cutter 4½ inches diameter, with 14 inserted teeth made of high-speed steel, cutting at 70.7 feet per minute. Depth of cut, 5-32 inch; width of cut, 3 inches; feed, 8 inches per minute.

Milling Medium Gray Iron with face-milling cutter 9 inches diameter, twelve inserted teeth made of high-speed steel, cutting at 80 feet per minute. Depth of cut, ⅛ inch; width of cut, 6 inches; feed, 8½ inches per minute.

Milling Medium Gray Iron with face-milling cutter 12 inches diameter, with sixteen inserted teeth made of high-speed steel, cutting 75 feet per minute. Depth of cut, 5-32 inch; width, 11 inches; feed, 7.5 inches per minute.

Cylindrical Cutter Milling Mild Steel.—Cutter made from high-speed steel, 2¾ inches diameter, twenty-one teeth, running at 72 feet per minute. Depth of cut, 5-32

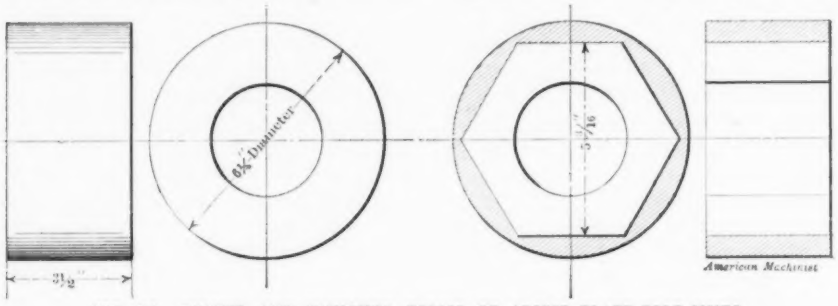


FIG. 13. ROUGH AND FINISHED FORMS OF ARMOR PLATE BOLT NUTS.

*A paper read at the New York meeting of the British Iron and Steel Institute.

inch; width of cut, 3 inches; feed, 7½ inches per minute.

Cylindrical Cutter Milling Mild Steel.—Cutter, 3 inches diameter; ten teeth running at 70 feet per minute. Depth of cut, 5-32 inch; width, 11 inches; feed, 3 inches per minute.

Cylindrical Cutter Milling Gray Iron.—Cutter, 2½ inches diameter, twenty-one teeth, running at 87 feet per minute. Depth of cut, 1-16 inch; width, 2¾ inches; feed, 26 inches per minute = .195 per turn = .0093 per tooth. With same cutter finishing cut was taken 155 turns per minute = 111 feet; depth of cut, 1-64 inch; feed, 6½ inches per minute.

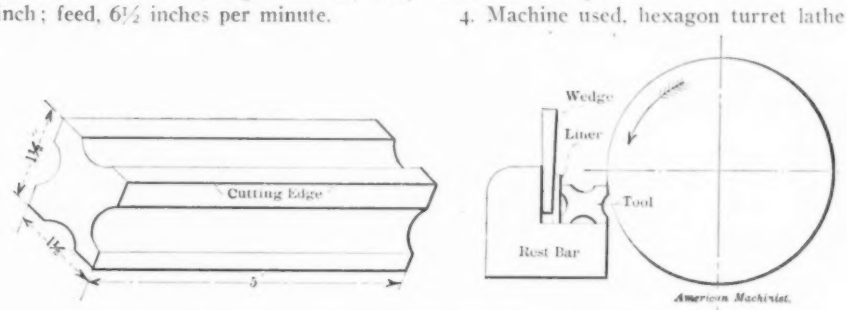


FIG. 14. FORM AND METHOD OF HOLDING TOOLS FOR ROLL TURNING.

Gear Cutting, 5 inches pitch. Stocking cutter, 3½ inches diameter, cutting gray-iron spur gear from solid. Cutting speed, 75 feet per minute; feed, 14 inches per minute.

At the time the observation was made 5,000 teeth, 2¼ inches long, had been cut. The cutter appeared to be in as good condition as after cutting the first 100 teeth (13½ hours, nearly).

TURNING.

High-speed steel has so far been very successful on roughing 0.34 per cent. carbon steel armature shafts; the average time the tools last is about four hours. Occasionally a tool will last one day; this is owing to the variation in the steel being cut.

1. The cutting speed on this work is 54 feet per minute; 11 revolutions per inch of feed; ⅛ inch to 3-16 inch depth of cut. The operator grinds his tool two or three times a day.

2. A high-speed steel tool, 1¼-inch by 2½-inch section; depth of cut, 1¼ inches; feed, 7 cuts per inch; cutting speed, 36 feet per minute; planed across the base of a 5,500-kilowatt steam turbine body. The tool worked for 10 hours before requiring grinding.

3. Tool, 2 inches square high-speed steel; used in 28-foot boring mill; cutting gray-iron ring 16 feet 6 inches diameter; cutting speed, 40 feet per minute; depth of cut, 1 inch; feed, 5.3 cuts per inch. Tool worked 15 hours.

4. Machine used, hexagon turret lathe; roughing, ½-inch by 1-inch section; operation, reducing a 1¾-inch rolled bar to ¾ inch diameter; cutting speed, 38 feet per minute; feed, 100 revolutions per 1 inch of feed. The tool lasted for over 46 hours before regrinding was required.

5. Operation, reducing cold rolled steel bars by 3-32 inch in diameter; cutting speed, 160 feet per minute; feed, 3¾ inches travel per minute. The tool lasted for 23 hours before requiring regrinding.

MILLING.

6. "Some phenomenal results have been obtained with milling cutters on special tests; of course the work was not good enough for practical use, being furrowed like a ploughed field, but the cut was clean enough, the object being to get at the amount the cutters would stand before breaking the corners."

Slot cutter, 3⅛ inches diameter, ⅝ inch wide, 1 inch bore; 180 revolutions per minute = 147 feet; .050 inch per revolution = 9 inches travel per minute; ¼ inch depth of cut; material cut, mild steel. Cut for one hour in perfect condition without grinding.

With cut ⅛ inch deep, the feed was put up gradually until 42 inches table travel per minute was obtained, at which feed the machine pulled up; 37¾ inches per minute was run with success. It was not considered advisable to break the corners of this cutter, after behaving so well, the cutter running for about five hours on the severest test. Although well flushed with water, the chips came off blue, and were like planer chips when broad cutting. The cutter showed very little sign of wear.

7. Slot cutter, 3⅛ inches diameter, 1 3-16 inches wide, 1 inch bore; 120 revolutions per minute = 98 feet; .168 inch feed per minute = 19¾ inches travel; 1-10 inch depth of cut.

Cutting gray iron this cutter ran over 20 square feet of surface, and showed very little sign of wear when taken out.

MILLING AND GEAR CUTTING.

8. Straddle cutter, 3 inches diameter, 1 inch bore; cutting speed, 70 feet per minute; feed, 0.20 inch per revolution; 1⅝ inches travel; depth of cut, ¾ inch (in one cut).

Cutting slot, ¾ inch square, in end of mild steel blocks, the cutter did 2,200 pieces before requiring regrinding, lasting 80 hours.

9. Tool, steel angle cutter, 50-12; operation, milling tool steel; cutting speed, 72 feet per minute; feed, 0.03 inch, or 2.7 inches travel per minute; depth of cut, 5-16 inch.

The cutter worked for three hours, and was then in such good condition that the speed was put up to 84 feet per minute,

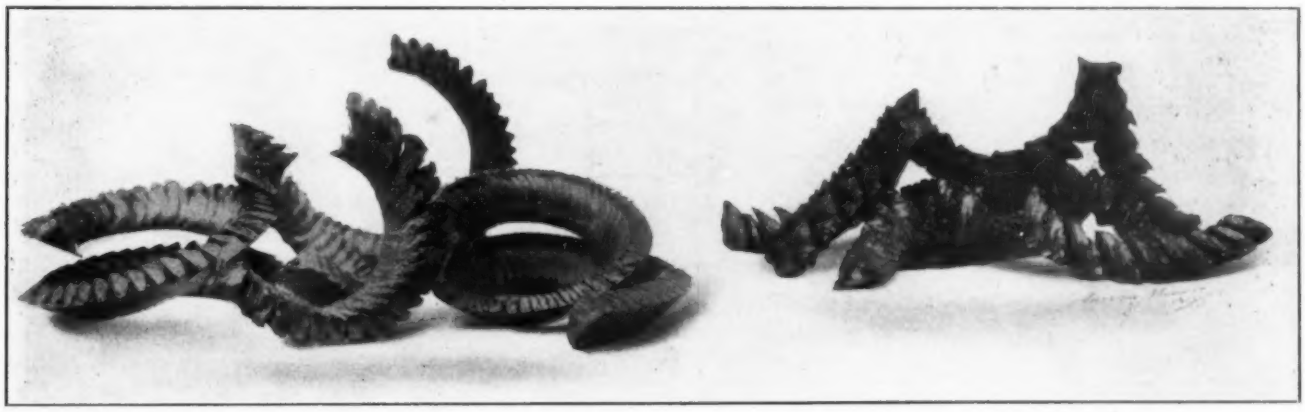


FIG. 15. CHIPS MADE AT A CUTTING SPEED OF 90 FEET PER MINUTE. DEPTH OF CUT, ⅞". FEED, ¼". METAL REMOVED PER MINUTE, 68¾ POUNDS.

FIG. 16. HEAVY CUTTING WITH COARSE FEED TO TEST BREAKING STRENGTH OF 1¼" SQUARE TOOL. DEPTH OF CUT, ½". FEED, ⅜". CUTTING SPEED, 25 FEET PER MINUTE.

and the feed to 0.036 inch or 3.8 inches travel per minute. The cutter then stood for 8½ hours before it required regrinding.

Following the previous tests, trials were made with high-speed steel for cutting gears, with results as follows:

10. *High Speed Cutter.* 8 inches diam-

eter, 2½ inches pitch; cutting speed, 57 feet per minute; feed, 3⅝ inches per minute; depth of cut, 0.862 inch.

Cutter lasted for three days before requiring regrinding.

Ordinary Carbon Steel Cutter, same size as above, as follows: Cutting speed, 27 feet per minute; feed, 1⅜ inches per minute; depth of cut, 0.862.

Average life of above cutter, made of *ordinary carbon steel,* is about 3½ hours. These cutters were used on cast-steel street-car motor gears, 0.50 per cent. carbon.

GEAR CUTTING AND DRILLING.

Cutting pinions, 0.34 per cent. carbon steel, for street-car motors.

11. *High-Speed Cutter,* 7 inches diameter, 2½ inches pitch; 57 feet per minute; 2⅜ inches feed per minute; depth of cut, 0.862 inch.

Average time cutter lasted, without grinding, was about 27 hours.

Ordinary Carbon Steel Cutter, 7 inches diameter, 2½ inches pitch; 30 feet cutting speed per minute; 1 5-16 inches feed per minute; depth of cut, 0.862 inch.

Average time cutters lasted, without grinding, was about 7 hours.

DRILLING.

12. Tool, ¾-inch drill; operation, drilling gray iron, medium hard, 4 inches thick; revolutions, 360 per minute; feed, 60 revolutions per inch of feed = 6 inches per minute. One hundred and thirty-seven holes were drilled before the drill required regrinding. Seventy-eight holes were drilled before the drill required regrinding.

GENERAL SHOP WORK.

Table 2 gives regular speeds and feeds, and involves about the same amount of grinding as with the Mushet steel at lower speeds. In the case of crank-pin milling, speed has been increased from 20 to 55 feet per minute.

Operation	Depth of Cut	Feed	Cutting Speed per Minute	Material
	Inches	Inches	Feet	
Turning	½	1/10	40	Steel crank axles, roughing.
	⅜	⅛	50 to 70	Shaft for built-up cranks, roughing.
	1/16	1/16	120 to 140	Shafts for built-up cranks.
	¼	1/10	60 to 70	Steel piston rods, roughing. Cross-head gudgeon pins, bolts for crank pins, &c., C. I. piston heads.
Vertical boring machine	⅛	1/10	50	C. I. piston rings, boring, turning, and parting off.
Inserted tools in large milling-head	⅛	⅛	55	Pins of steel cranks. *Note.*—Tools are subject to impact at each revolution of the wheel. Number of tools in head, 48.
Planing	½		25	Steel slabs for built-up cranks.
	⅓		35	Steel horn blocks, &c., also on gray iron

TABLE 2. PARTICULARS OF WORK DONE BY HIGH-SPEED TOOL STEEL.

GENERAL SHOP WORK.

"The following are a few rough notes relating to the performance of high-speed steel":

1. When turning ends for large rolls with a cutting speed of 80 feet per minute on hard steel; depth of cut, ⅜ inch, and a feed of 8 to the inch. In this case the tool was cutting seven hours before being reground.

2. When turning piston rods with a cutting speed of from 110 to 120 feet per minute; depth of cut, 3-16 inch; feed, 16 to the inch. In this case a heavier cut could have been taken.

3. Turning cones cut from 6-inch bore solid drawn steel tubes with a cutting speed of 160 to 180 feet per minute. By using high-speed steel the output was rather more than doubled.

4. On ordinary gray iron a speed of 80 feet per minute was attained with cuts to

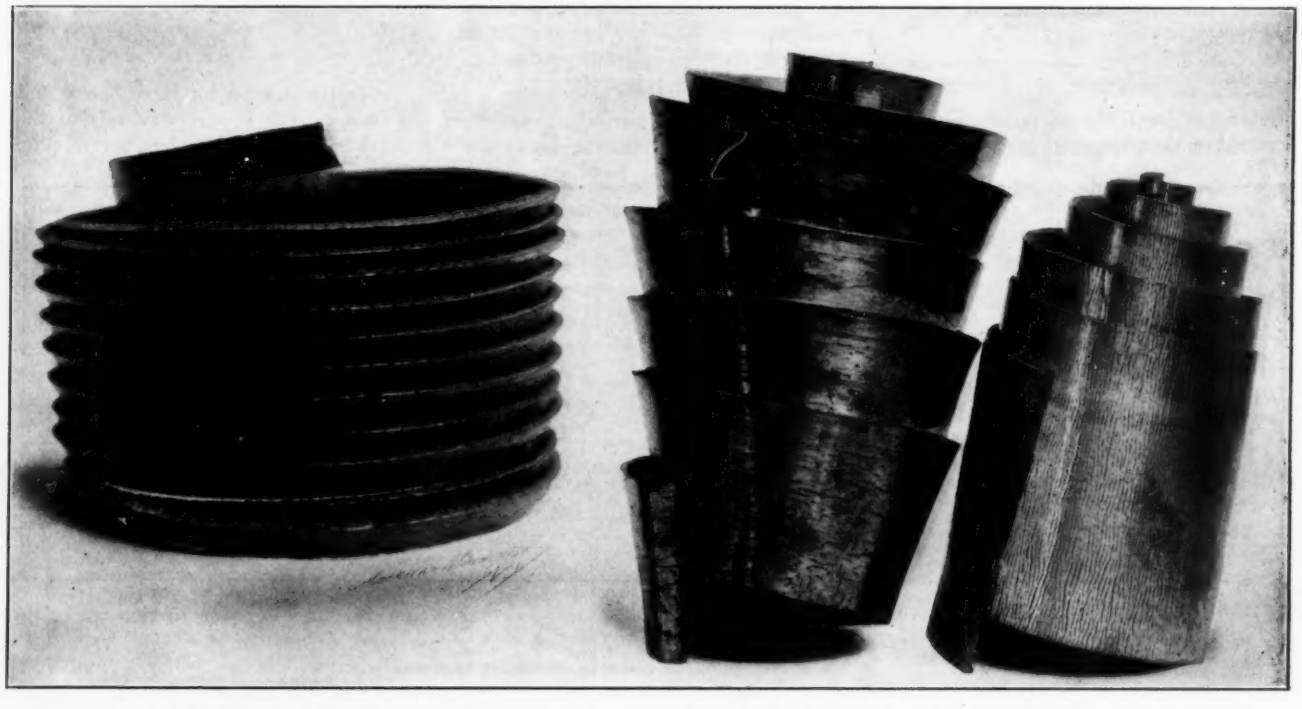


FIG. 17. CHIP FROM FORGED STEEL OF 55-POINT CARBON. CUTTING SPEED, 50 FEET PER MINUTE. DEPTH OF CUT, 3-16". FEED, 1-16".

FIG. 18. PLANER CHIPS FROM ARMOR PLATE. CUTTING SPEED, 12 FEET PER MINUTE. THE BROAD CHIP AT THE RIGHT IS 4" WIDE.

13. Tool, 1-inch drill; operation, drilling gray iron, medium hard; revolutions, 240 per minute; feed, 5 revolutions per 1 inch of feed = 4⅜ inches per minute.

suit the class of work in hand, but no difficulty is found with cuts ½ inch deep, ⅛ inch feed.

5. Since adopting high-speed steel on planing machines, steel castings have been cut at 30 feet per minute instead of 17 feet, as formerly.

6. High-speed steel for milling cutters has given every satisfaction. On all ordinary light work 160 to 240 feet per minute have been cut with very satisfactory results.

"Enclosed is a report relative to testing of high-speed steel."

rope pulleys, cylinder covers, etc., the cutting speed on an average is from 50 to 60 feet per minute; the depth of cut and feed varying from 1-16 to ¼ inch per revolution.

GENERAL SHOP WORK.

"The speeds indicated below are those of regular practise, but at the same time it may be stated that even better results than these are possible, on small shafting cutting speeds of 200 feet per minute being easily attainable."

Rough Turning with High-Speed Steel.—Hard gray-iron rolls, 50 feet per minute, to 1¼ inches diameter, gray iron, wrought iron, or cast steel.

"The following is a very good example of rapid cutting on a gray-iron drum, 12 feet diameter by 5 feet face; this was turned from the black at a speed of about 35 feet per minute. The second cut was made at a speed of 50 feet per minute: depth of cut, ⅛ inch, with 1-12 inch traverse. In this instance the tool completed the entire surface of the drum without once regrinding, and was in excellent condition at the termination of the work. Two similar cuts have also been done over a

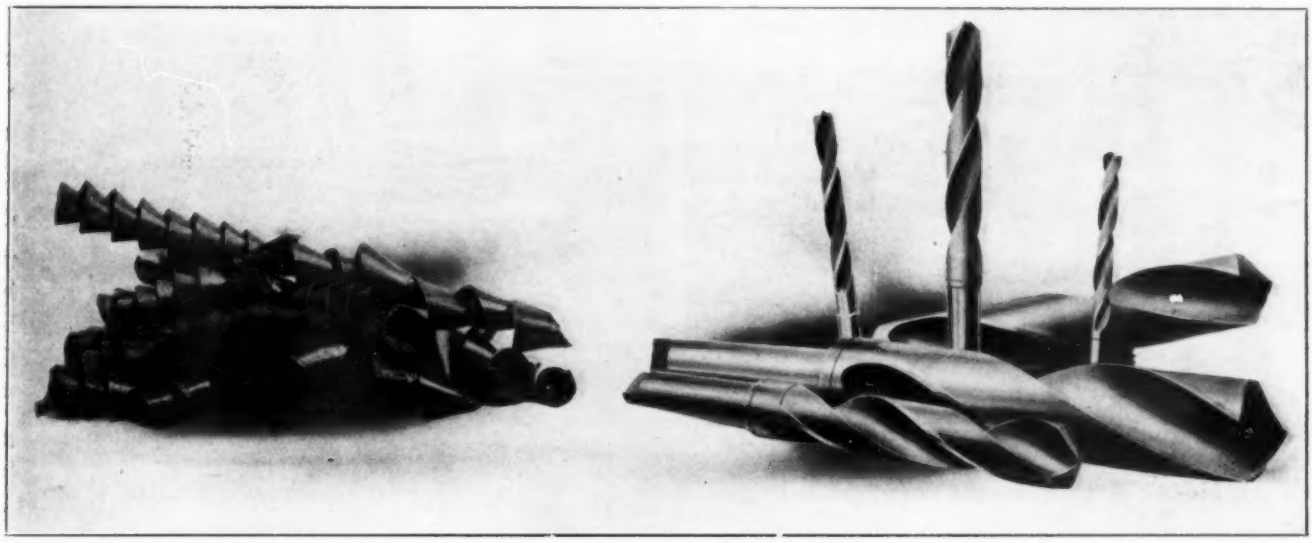


FIG. 19. TWIST DRILL CHIPS FROM STEEL PLATE. CUTTING SPEED, 75 FEET PER MINUTE. NOTE THICKNESS OF THE CHIPS.

FIG. 20. TWIST DRILLS OF HIGH-SPEED STEEL. ONE OF THESE DRILLS, OF 15-16" DIAMETER, DRILLED, WITHOUT GRINDING, 7,924 HOLES THRU GIRDERS MADE UP OF FIVE PLATES AND ONE ANGLE-IRON, THE TOTAL THICKNESS BEING 2½". FEED, 3.66" PER MINUTE.

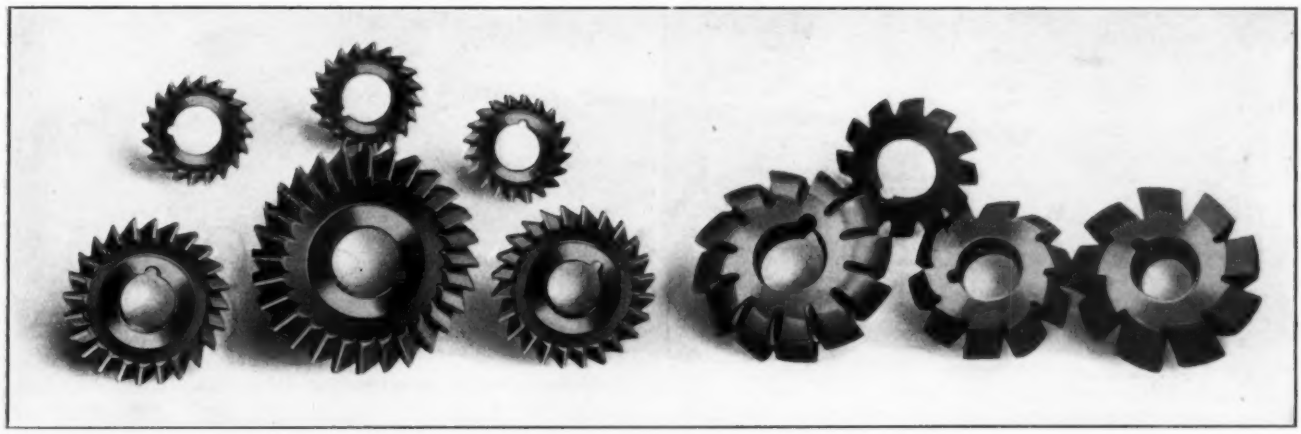


FIG. 21. MILLING CUTTERS OF HIGH-SPEED STEEL.

FIG. 22. FORMED MILLING CUTTERS OF HIGH-SPEED STEEL.

Test on forged crankshaft, 22 inches diameter, was as follows: Cutting speed, 63 feet per minute, ¼ inch feed; ¼ inch deep at this speed and feed, the tool without being reground cut for 4½ hours; at the end of this time the tool was not punished.

Turning flywheel, 16 feet diameter; cutting speed, 50 feet per minute; ⅛ inch feed; depth of cut, ¾ inch.

For gray iron, such as flywheels and ⅛ inch feed, 5-16 inch deep. Roll, about 20 inches diameter by 60 inches long. A tool will turn three or four rolls without grinding.

Cast Steel.—30 to 40 feet per minute; feed varying according to cut.

Mild Steel.—90 feet, ¼ inch feed, ¼ inch deep.

Planing.—Gray iron and steel, 30 feet per minute.

Drilling.—4 inches depth per minute up drum of exactly the same diameter as above with the *same tool*, without regrinding from start to finish, at a speed of 50 feet per minute and without losing 1-64 inch in girth on the drum during the operation (27¼ hours' cutting)."

"A few examples of the results of work with high-speed steel and drills are herewith submitted, the same being results of daily usage and not test results. Much

higher average results could be obtained were the belt powers of the lathes and drilling machines not rather limited."

Turning.—Roughing mild steel bars of 3⅜ inches diameter for worm shafts. Maximum speed, 150 feet per minute; minimum speed, 70 feet per minute; depth of cut, 3-16 inch; feed, 5 inches travel per minute; tool works 7 to 8 hours without grinding.

Facing Gray Iron.—Speed, 75 feet per minute; depth of cut, ⅛ inch; feed, 1-16 inch.

Turning Hard Gray-Iron Ram.—Speed, 45 feet per minute; depth of the cut, 3-16 inch; feed, 1-16 inch.

Planing.—Speed, 34 feet per minute; depth of cut, ⅜ to ½ inch; feed, 1-32 inch; tool works 6 hours without grinding.

Drilling with High-Speed Twist Drills.—¾-inch drill, drilling gray iron and mild steel; speed, 200 revolutions per minute; feed, 15⅝ inches per minute.

Ordinary Twist Drills will not stand at the speed at which high-speed drills are run, and are destroyed immediately, the practise being to run ordinary drills two speeds slower than high-speed drills.

DRILLING.

"A high-speed twist drill, 15-16 inch diameter, used for drilling steel girders consisting of five ⅜-inch plates and one ⅝-inch angle iron = 2½ inches thickness in middle of girders and 1 inch at ends, drilled 7,924 holes before sharpening, and in the case of another similar drill 6,504 holes were drilled before sharpening, the drills running 275 revolutions per minute with a feed of 75 cuts per inch, equal to a feed of 3.6 inches per minute. Formerly when using ordinary twist drills of ¾ inch and ⅞ inch diameter the speed ranged from 96 to 115 revolutions per minute, and feeding about ⅝ inch to 1 inch per minute. These figures speak for themselves, the life of the ordinary drills formerly used being well known to most engineering firms."

TURNING CHILLED ROLLS.

"As is generally known, the surfaces of chilled gray-iron rolls are so extremely hard that, in turning them, only the very best steel is of any use, and the cutting speed must be exceedingly slow.

Moreover, in turning large plain chilled rolls, sharp or narrow-pointed tools, such as are used on general traversing lathe work, would not stand at all, the form found to answer best being as shown on sketch above. These tools are wedged against the barrel of the rolls, as shown in Fig. 14.

Hitherto the circumferential cutting speed generally adopted has been about 6 feet per minute, and the reduction of the metal very small. With this tool, if the cutting speed were increased, or a heavier cut put on, the edge of the tool would promptly fail. By using high-speed steel it was found practicable:

(1) To increase the cutting speed from 6 feet per minute to 11 feet per minute.

(2) To put on a much heavier cut.

(3) In addition to the above advantages of quicker work and heavier cutting, the special tool referred to will last much longer without taking out for self-cooling or grinding."

[Figs. 15 to 26, inclusive, illustrate some of the exhibits made at the reading of Mr. Gledhill's paper, either by samples or by photographs. In most cases the illustrations are self-explanatory, but regarding the formed milling cutters shown in Fig.

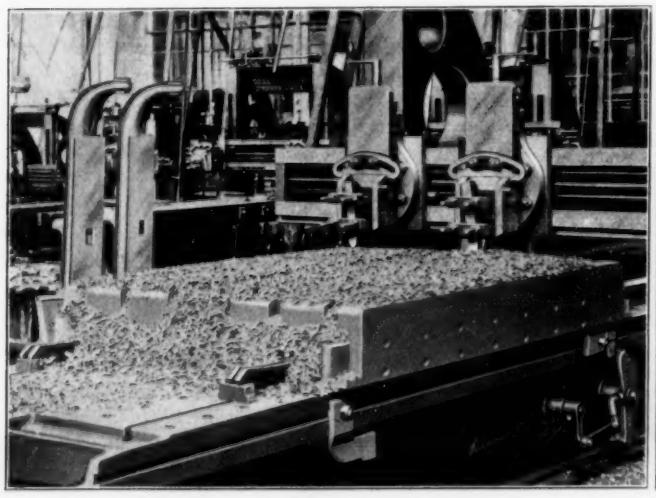


FIG. 23. PLANING BASE PLATES. CUTTING SPEED, 40 FEET PER MINUTE. DEPTH OF CUT, 5⁄8". FEED, 1⁄8".

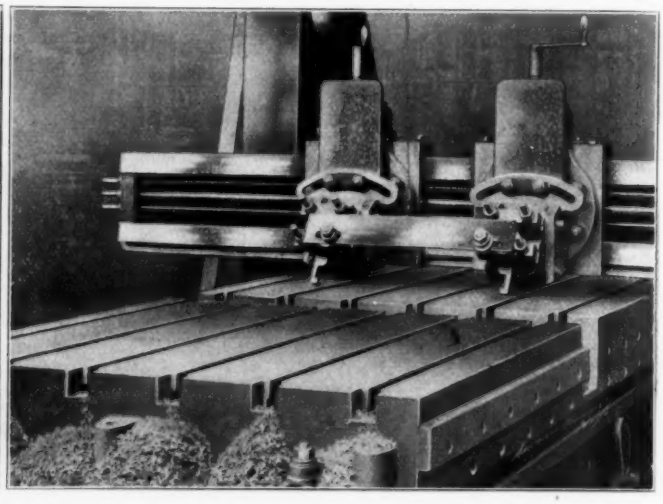


FIG. 24. PLANING BASE-PLATE T-SLOTS. CUTTING SPEED, 40 FEET PER MINUTE.

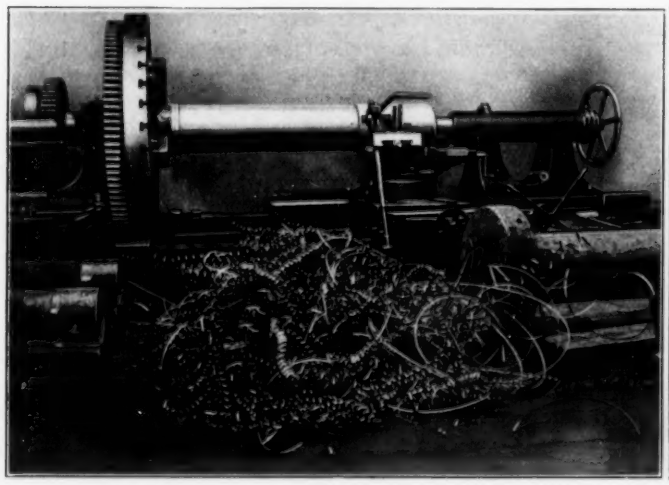


FIG. 25. FORTY-FIVE MINUTES' WORK. CUTTING SPEED, 150 FEET PER MINUTE. DEPTH OF CUT, 3-16". FEED, 1-16".

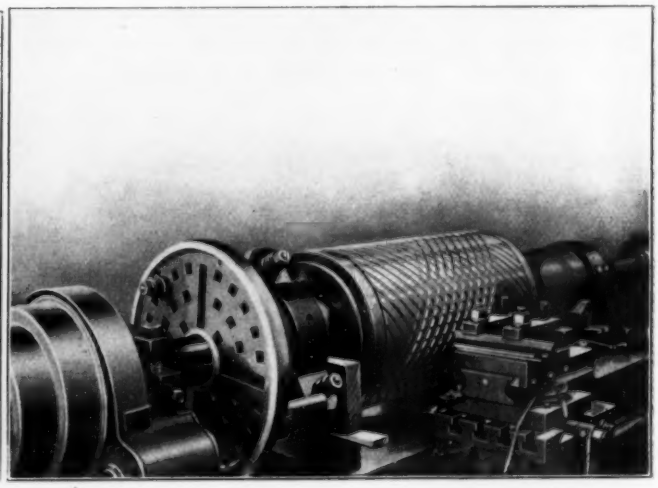


FIG. 26. TURNING AND GROOVING CHILLED GRAY IRON ROLLS.

22, it should be stated that they showed no trace of the high hardening heat to which they had been subjected—the marks made by the tool of the relieving lathe being as clearly visible as in cutters of carbon steel. These cutters were heated for hardening in the furnace shown in Fig. 2. Fig. 27 shows a curio in the form of a tool having a chip *welded* to it by the heat due to the work. The form of the tool will be seen to be intact, no destructive action having occurred.—Ed.]

Some Gas Engine Troubles.

BY JUNIOR BOSS.

In the course of a number of years' experience with gas engines, after they have left the factory, many curious troubles have been brought me for rectification; tho probably there is nothing unique in the cases I shall note, as something akin has doubtless come the way of most gas engine men.

I was sent for to examine a 30 brake horse-power Otto cycle engine which was getting water into the liner. The usual symptoms—refusing to start and bursting tubes—were present. I diagnosed it as a leaky liner joint. The liner was drawn and a new joint carefully made, every precaution being taken. The facing on the end of the liner and its seating in the combustion chamber were scraped, a new asbestos ring was inserted and the liner pulled into place. Imagine my surprise on starting up the engine to find that water was still as much in evidence as ever. The boss of the place (a printing office) was getting sore, and I was wondering already what he would have to say about the bill. There was nothing to do but pull the jacket down again and take out the liner. This time the joint faces were skimmed in the lathe and I felt pretty sure that they would hold this time. After working all night so as to get them started at 8 o'clock next morning, we got the liner back into place and again started up. Alas! the troubles were by no means over, the water whistled down the air valve spindle and out of the lubricator on the top of cylinder. It could not be the liner, and the exhaust chamber was as dry as a bone. The office had been standing a day and a half and Mr. Printer was naturally getting past holding. We were all pretty well played out, too. The liner was not cracked, the joints were tight, and yet water in comparatively large quantities was getting in. It looked as tho we must throw the job up when some trivial circumstance, now forgotten, directed our attention to the air pipe.

"Get that foot plate up," the fitter said to one of his mates, indicating the iron plate covering the pit in which the air box stood. "Now get the top flange off." The man took the flange off, and to our astonishment discovered that the air box was full of water. The mystery was of course solved—the engine had been pumping water on every charging stroke. A leak at some time or gradual condensation had filled the air box, which in this engine was sunk rather low. It all looked so simple, but I have never met with a similar case before nor since. Whenever a man goes from our shop now to see a gas engine with a water trouble the air box isn't overlooked.

"Send around to see our gas engine at once, will you?" This by telephone. "What's wrong?" "Going to pieces, by the sound of her." We were short of men at the moment, but young Jim was around and he was a promising tyro in the gas engine line. Jim went and about an hour after rang up to say the engine was bumping like fury and he couldn't tell why. The crosshead and crank brasses were all right and the main bearings were as right as when the engine left the works. I sent the indicator along and told Jim to see if she was pre-igniting. No, that wasn't it. After cruising round for another half hour Jim accidentally found that the flywheel key was loose. He carries a flogging hammer with him now when an engine takes to thumping.

FIG. 27. A TOOL WITH CHIP WELDED ON.

Another time a fitter was sent in answer to an urgent call just after dinner. He arrived and found the governor himself in the engine-room and three fellows lugging at the flywheel. It seemed that the regular attendant had not returned at the usual time and they were trying to start. After looking round and apparently making one or two adjustments, our fitter got the engine away. "What was the matter, Tom?" I asked on his return. "Nothing, except that they forgot to turn the gas on."

A set of slides off an old slide type engine was sent us one day to be refaced. The job was done by a skilled hand and returned. Two days after a letter came saying the slides were not properly done and would not hold and that they were being returned to us to be done over again. The letter concluded by saying that of course we would have to bear the expenses incurred by the second refacing. We replied, saying we could not understand why the slides should be wrong, as they had been done in a proper manner and tested on a special test plate before being sent out. The slides came to hand and were found to be correct. We wrote back, informing our clients of this and asking them to try them again and look in other directions for the trouble. Another letter came, saying the slides were as bad as ever and that we must send down to see to them. We agreed on condition that they should pay the bill if we proved the slides were faced right. On examination our fitter discovered that the lugs on the cylinder end which kept the slide cover in position were bearing against the cover and keeping it away from the slide. This was caused by the thinning of the slide by continual refacing and a few rubs with a file put it right.

We had a lot of hot-bearing troubles once with a high-speed engine of 40 brake horse-power. There was one heavy flywheel of about 5 tons hung between the main frame of the engine and an out-end pedestal. There were thus three bearings and they were all heating in turn. The engine had been laid down about eight months and had previously given no sort of trouble. There was nothing that could be detected wrong with the bearings. The oil was all right in quantity and quality, and there was no pounding or scoring apparent. Castor oil and flour sulfur were tried without result. The outside bearing was the worst, the other two after a while running fairly cool. This localization of the complaint to the one bearing led, after a good deal of time and trouble, to the discovery that the concrete foundation under the pedestal had subsided about 1-16 inch, and the bearing cap was thus tending to spring the shaft. The pedestal was packed up and the trouble disappeared.

"Engine stopped dead. Can you send a man along quick?" Telephone again, this time a new customer. Not having a man handy whom I cared to send to a new job, I went myself. I found the engine stopped with the belt on the tight pulley. After a lot of effort by as many men as we could find room for on the flywheel, we got the belt over on the loose pulley. The engine was got off with little trouble, but as soon as we attempted to put the load on, she started missing fire and in a minute or two stopped. I examined the gas bag, tried the valves up and down, tried the compression, and all appeared right. I was thinking about sending for the indicator when I happened to inquire which way the exhaust was taken. The attendant said it went a long way out to the back of the building and up level with the roof. I inquired if there was a silencer. He said there was a box on the end of the pipe, but he didn't know anything about a silencer. The vagueness of the answer made me suspect that there was a silencer and from his apparent ignorance of it that it had probably not been cleaned since its installation. Up to the roof we went, and sure enough there *was*

a silencer. "Fetch up a ¾-inch spanner and get that flange off and yell out when you have done it." Leaving him with these instructions, I went below and waited for him to yell, which he shortly did. As I expected, the engine rattled off with the load immediately. That silencer gets cleaned out once a year now.

"Go down to Mr. Bootmaker's and look over his gas engine. He says she has sprung a leak." Jim goes again this time and presently reports that he has drawn the piston and there certainly is a leak, but it doesn't seem to come from either of the joints. As the engine is a small one and the shop quite handy, I tell him to arrange to get the cylinder off and bring it home at shutting-off time to-night. On examination it looked as tho Jim's version was right. The liner and exhaust joints both appeared tight. Was there a crack? Before taking the liner out, we decided to put the force pump on to see if we could detect the spot the water came from. We filled up the jacket, blanked up the bottom water connection and stuck the pump on the top one. A few strokes enlightened us. The water was coming from the indicator hole. We could only conclude that the boss thru which the indicator hole traveled from the outer shell of the jacket to the combustion chamber was cracked *in the water space*. We plugged up the hole on the inside and stopped the leak. If a stranger ever comes to indicate that engine, there will be trouble.

Another hot-bearing difficulty which we traced to an unusual cause was experienced with a large single-cylinder engine giving 120 brake horse-power. The engine was some years old when the bearings on the big end of the connecting rod started to run hot. The mechanic employed on the establishment had exhausted his ingenuity and given it as his opinion that new bearings were wanted. We were rung up to give a figure for this and as a result inspected the faulty brasses. They were a heavy, well-made set (the journal was 8 inches diameter), they were not worn or damaged in any way and we could assign no reason for their failure. As it appeared to us to be folly to make new brasses when no defect could be discovered in the old ones, we suggested that we make an examination of the engine. The brasses were scraped and the journal smoothed down and a red lead fit obtained. The lubricator was seen to and the engine started on castor oil. All went well for a while, but as soon as the load was put on trouble began. We went over this routine of refitting the brasses several times, as we found that when heated they had a tendency to close on the journal. To obviate this we shaped the edges of the brasses so that they should bear on the outsides and thus any tendency to expand would cause them to open instead of close. Still the heating continued and at last we decided, as a means of calculating the pressure on the bearing, to indicate the engine. This decision saved us, for the indicator at once discovered an abnormally high initial pressure, due to pre-ignition, which was eventually traced to a faulty igniter. This was corrected and the gearing gradually cooled down and has since given no further trouble.

Bristol, England.

Power Calculations for Electric Vehicles.

BY H. H. KENNEDY.

To calculate the power equipment of a vehicle propelled by storage batteries and electric motors, the weight to be moved, the required speed and corresponding drawbar pull are the quantities first to be decided on. The weight will, of course, be determined by the method of construction adopted by the designer. The general practise in the matter of speed for the regular types of pleasure vehicles is between 20 and 13 miles per hour. In deciding on the speed, the mileage must be considered, as it is not practicable to overload or go beyond a certain number of cells of battery for a car to be used daily for business or pleasure. For instance, if the car desired is a light runabout and a large mileage and speed are desired, the necessary weight of battery would make anything but a light runabout of it, not to speak of the initial cost and maintenance for a car of this type. In the case of heavy vehicles the same conditions have been found to exist. The relation of weight, speed, mileage, cost of maintaining and initial cost of battery limit the practicable speed to the figures given in Table 1 for trucks of different capacities, the figures being representative of general practise:

5 ton	5 to 6	M. P. H.
4 "	6	"
3 "	7	"
2 "	8 to 10	"
1 "	10	"
½ "	11	"

TABLE 1. SPEEDS OF ELECTRIC TRUCKS.

As to the drawbar pull, there are a great many things that affect its value, the efficiency of the transmission, the tires and rolling friction, the road surface and the wind resistance being the most important.

The designer will have to use approximate figures until he has made tests for himself on the class of vehicles he chooses to build. Table 2 gives some figures on drawbar pull which will give very close to the actual results.

Type of Vehicle	Speed M.P.H.	Road Surface	Transmission	D. B. Pull lbs. per 1000 lbs.	Tires
1 to 5-ton trucks	5 to 10	Asphalt	Side chain drive	18 to 20	Solid Rubber
Runabout	13	"	Double reduction gear drive	22	Pneumatic
"	20	"	"	26	"
"	"	"	"	23	Solid Rubber

TABLE 2. DRAWBAR PULL FOR ELECTRIC VEHICLES.

The figures of Table 2 are for level roads. As may be seen, the wind resistance plays an important part above 10 miles per hour. The formula for wind resistance is:

$$\text{H.P.} = \frac{A\,V^3}{75{,}000}$$

where

A = area of surface exposed to wind resistance,

V = velocity in miles per hour.

There is also a great difference in tires. I have tested two different makes of pneumatic tires, that gave as much as 4 pounds difference in the drawbar pull. As to the road surface, there is hardly any way of approximating the drawbar pull on the mixtures of road met with in the country, the pull going as high in some bad places as 500 pounds per 1,000 pounds. However, for the average city streets the figures given are very near the mark.

Having settled on the data from which to calculate the power equipment, it remains to find out how to proportion the gearing, for the power required and the ratio of speed to torque in the motor.

The brake horse-power required of the motor or motors is determined by the following formula:

$$\text{H.P.} = .0026\,M\,W\,P \qquad (1)$$

where

M = miles per hour of vehicle,

W = weight to be moved in 1,000 lbs.,

P = drawbar pull per 1,000 lbs.

If the motor is to be designed to fit a certain running gear whose gear ratio is already fixed, the data for the design of the motor will be obtained from the power required and the gearing.

Let

D = diameter of wheel in inches,

R = gear ratio from motor to wheels,

S = motor speed in R. P. M.,

T = motor torque in pounds at 1 foot radius.

Then

$$S = \frac{336\,M\,R}{D} \qquad (2)$$

$$T = 5252\,\frac{\text{H.P.}}{S} \qquad (3)$$

The motor being designed to give the power from (1) at the speed from (2), and torque from (3), will give a wagon of weight W a speed of M miles per hour, the gear ratio being R.

If the motor is already designed the gearing must be determined from the characteristic curves of the motor, such as those shown in Fig. 1. These curves have been obtained from a brake test of the motor, and represent the brake horse-

power, efficiency, speed and amperes for any given torque. Calculating the horse-power from (1), the curves show the corresponding torque and speed. The gear ratio required for M miles per hour may then be determined from the motor speed by the formula:

$$R = \frac{D\,S}{336\,M} \qquad (4)$$

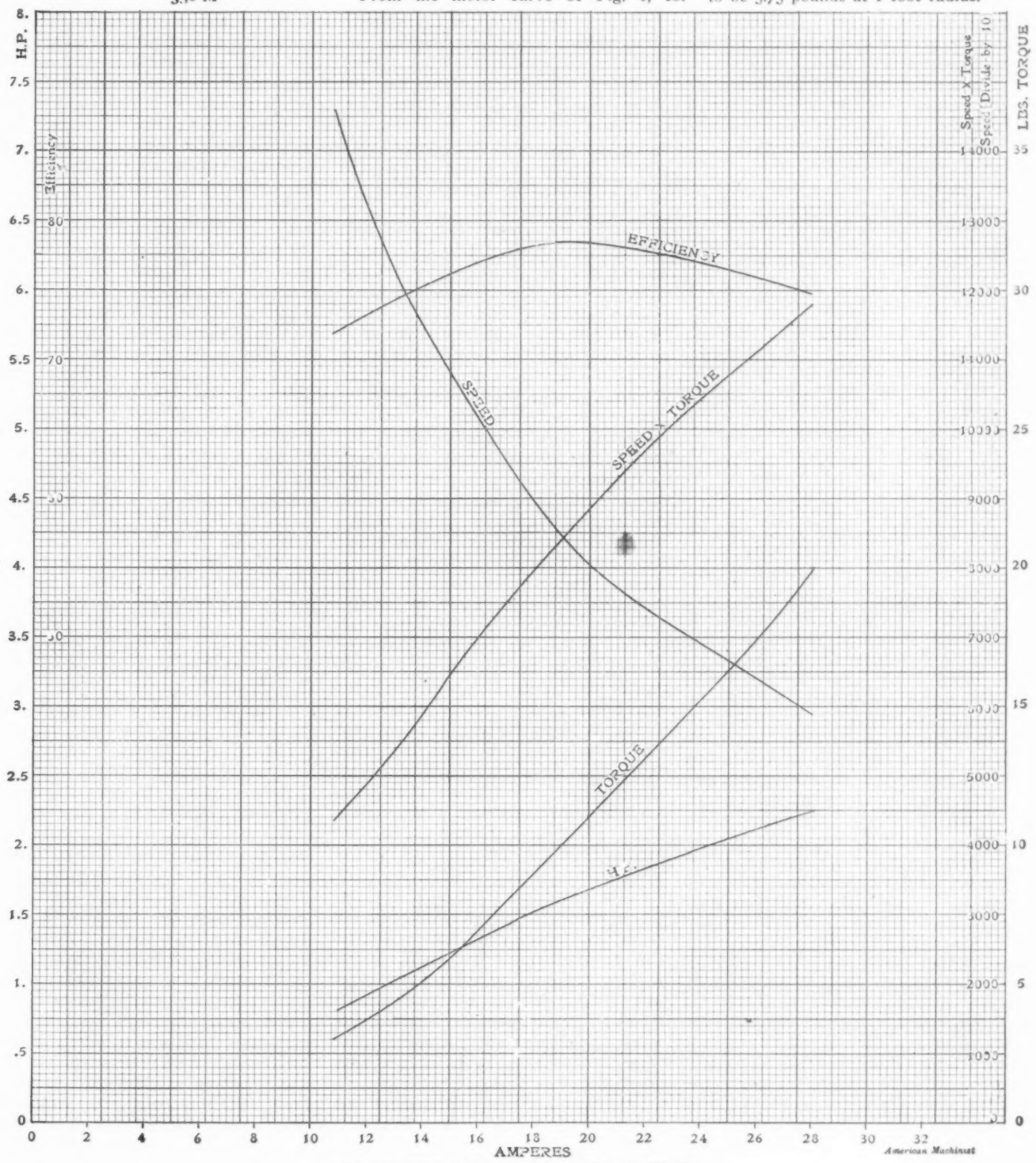
and a speed of 12½ miles per hour. Assume also a drawbar pull per 1,000 pounds of 26.4 pounds.

From formula (1)

H. P. $= .0026 \times 12.5 \times 2.76 \times 26.4$
$= 2.4.$

Since two motors are used, each motor will have to develop 1.2 horse-power. From the motor curve of Fig. 1, for power, 1.2 horse-power is found where the horse-power curve intersects the horizontal line representing 1.2 horse-power, as indicated by the scale for horse-power at the left. Passing upward along the vertical line from this point on the horse-power curve, until the speed curve is reached, then horizontally to the right, the corresponding speed of the motor is found to be 1,100 revolutions per minute.

Passing downward to the torque curve from the same point on the horse-power curve, then horizontally to the right, the torque is found in the column so marked to be 5.75 pounds at 1 foot radius.



CHARACTERISTIC CURVES OF AN ELECTRIC MOTOR.

If R is too large for single reduction, double reduction may be used, dividing R into two convenient factors.

As an example of the method of applying the preceding formulas, assume a vehicle having a weight of 2,760 pounds

From formula (4)

$$R = \frac{30 \times 1{,}100}{336 \times 12.5}$$
$$= 7.85,$$

the required gear ratio for 30-inch wheels.

The preceding calculations have all ig-

nored the existence of volts and amperes. A shorter but not so accurate method of determining the power of the vehicle is to calculate the volts and amperes from the watts per ton-mile. This method is dependent on the efficiency of the motor as well as the variable quantities of power consumption already mentioned. The watts per ton-mile are as variable, therefore, as the drawbar pull. To determine the watts required to propel the vehicle, use the following formula:

$$w = \frac{C \times W \times M}{2} \qquad (5)$$

where

w = watts = volts × amperes,
C = watts per ton-mile,
W = weight in 1,000 pounds,
M = M. P. H. of vehicle.

The watts per ton-mile vary from 85 for trucks to about 140 for pleasure vehicles.

Having determined the watts from formula (5), the amperes can be found by dividing the watts by the voltage. The voltage is determined by the number of cells of battery used, allowing 2 volts for each cell, of any size, 88 volts being about the limit, as that is all that may be charged on a 110-volt circuit, without throwing the batteries in parallel, which is objectionable, as it soon unbalances the voltages of the cells. From the characteristic curves of the motor the horse-power, torque, speed, efficiency, etc., can be found to correspond to the required amperes, and the gearing calculated as before. The horse-power can also be obtained by dividing the watts by 746.

To select the battery for the car, the number of cells, and consequently the voltage is determined by the voltage of the motor, unless a motor is to be specially designed. The greater the number of cells the more work is required to take care of the battery. On the other hand, with a high voltage there will be less loss of current in charging, and consequently less cost to charge, as charging is usually done from 110-volt circuits. Also, with a given speed the higher the voltage the less the current required to run the vehicle, as for a given speed the watts required are constant in the same vehicle under the same conditions.

The capacity of a battery is rated in ampere-hours—that is, it will give so many amperes for a given number of hours. A 96-ampere-hour battery at 24 amperes normal rate of discharge will give 24 amperes for four hours. As soon as the voltage and current are calculated, a battery must be selected that has a normal rating equal to the current required to run the car. If a 96-ampere-hour battery rated at 24 amperes discharge is used on a car taking 30 amperes, the efficiency and life of the battery will be diminished. If the car takes less than 24 amperes, the efficiency and life of the battery will be correspondingly increased.

$$\text{Mileage} = \frac{\text{amp. hrs. of battery}}{\text{av. amp. of vehicle}} \times \text{M. P. hr.}$$

For example:,

$$\text{Mileage} = \frac{96}{24} \times 12 = 48 \text{ miles.}$$

where 24 amperes is the average running current on the trip, 12 miles per hour = speed and 96 ampere-hours is the capacity of the battery.

Catalogs for the Foreign Trade.

For years past it has been a disputed point whether it pays to prepare, illustrate and translate into several foreign languages, catalogs intended for the foreign trade. Some engineering firms have found that it is better to issue a leaflet or short, illustrated description of their principal products instead of publishing a bulky volume. There is no doubt that it is a big item to produce a really good catalog for the foreign trade; but there can also be no doubt that if it is attempted it should be done well. Translations should be done by persons who are not only competent in the foreign language but also perfect in English and well up in mechanical matters. I have seen some foreign catalogs that were so badly translated as to excite derision among the recipients. A certain number of American engineering firms—who have gone into the export trade seriously—have issued catalogs second to none ever published; but the same cannot be said for others. But the best class of Amercan catalogs, dealing with mechanical subjects, is now rather better than the same sort of thing produced in England. Generally, it may be said that the conservatism which still dominates British business methods has much to do with the apparently indifferent showing made by English machine-tool makers in comparison with American manufacturers. Probably in no respect is this adherence to old ideas more apparent than in the manner in which the merits of a tool are brought to the notice of prospective buyers. In England it is not a common occurrence to meet with a catalog which gives such detailed particulars, drawings, etc., as will enable the actual construction of the machine to be made out and a probable estimate of its capabilities obtained. Instead of this, we are usually treated to a number of large wood cuts, together with a few leading dimensions, weights, etc. which give the prospective buyer little or no information on the points of the machine in question, and so it is in the descriptive accounts of machine tools in the technical press, because we find that, as a general rule, only the most meagre information is given by the makers. Usually, the American machine builder takes the prospective purchaser into his confidence, giving information which would almost enable any builder, who is so disposed, to make the machine. English makers object to this procedure, considering that it gives too much away; but judging from results, the policy of the American makers seems to be justified.

A case in point occurred some little time ago in Malta. A certain Western firm of carriage manufacturers sent some catalogs to Valletta, replete with illustrations, and containing a large amount of descriptive printed matter. Prices f. o. b. New York were given, and the manufacturers even went into the matter of the cubic measurement of each article, crated, and also the weight and the rate of freightage by steamer to many ports in foreign countries. The information was so complete and acceptable that several people sent orders for the carriages. Again, in Formosa, a similar instance may be quoted. The importers there complain that most British catalogs are lacking in information. American manufacturers seem to prepare their catalogs with a view to catering for their customers, who, in this case, were farmers. The information supplied is complete, not only specifying the construction and particulars of the parts of the machinery, but actually giving much information as to the working of the rice mills (rice mills were the goods being introduced by United States makers), with a deal of information likely to be useful to the miller. Prices of American rice mills in Formosa are about 20 to 30 per cent. cheaper than those of British make, but the latter are of heavy construction and last longer. Improvements, however, are being made at such a rapid rate that it is doubtful if it is not more profitable to buy machinery which costs 30 per cent. less to last a little shorter time than to buy heavily built machinery at greater first cost, which, before long, will be out of date; too good to be discarded, but too obsolete to compete with machinery having the latest improvements. One of the Formosan rice mills has a sheller, made in U. S. A., capable of shelling 20 tons of paddy a day with six horse-power, against a British machine of the same capacity, which requires 20 H. P.

These are facts to be weighed by intending users, especially in a new country, where the use of machinery is opposed to the old-established customs of the natives, and where the first cost is a great consideration, since the purchase would be an experiment regarded as more or less risky. British manufacturers seem to cater only for establishments having a practical engineer on the spot, who understands the whole machinery, while British catalogs too often only contain bald specifications, and little or nothing in the way of detailed information. With reference to this question of lack of detail, I may add that in consequence of this and the poorness of the illustrations, it occasionally happens that an importer gets quite different goods from what he thought he was ordering, in many cases making mere dead stock. A Bermuda firm write that from this cause they give American goods the preference, being certain that they will receive just what has been ordered.

F. C. C.

London.

Letters to the Editor.

Things That are Usually Wrong.

Under the above heading, at page 1500, Vol. 27, appears the first of what will without doubt be an excellent series of articles by Professor Sweet. As an engine designer I fully understand the "trick" of copying. Indeed, the more one considers it the more apparent it appears that there is scarcely a detail in a machine that could not, with the aid of a little consideration and scheming, be more or less—usually more—simplified in design and construction, with consequent reduction in cost. Designers are often conservative in nature, and with reason, yet this conservatism and reluctance to branch out in new paths is sometimes carried to a greater extent than is good for the work in hand. Perhaps we owe a good deal of this tendency to tread in well-known paths to that class of text book which supplies information in a condensed and handy form. But the text book must of necessity be to a certain extent out of date; the very latest in design and construction can hardly be served up hot to the reader, and there is, moreover, a natural dislike on the part of the purchaser to scrap his books of reference at the end of each twelve months and invest in fresh ones. But where the pocket book fails the periodical steps in, and it is therefore only by diligent reading of the best technical weeklies that one can claim any pretensions to up-to-date knowledge.

It was not, however, with any desire of moralizing that I picked up the pen to address you, but rather with the intention of "kicking" against one or two things which come to my mind that are "usually wrong." How often do we hear it said, in connection with the action of steam in a cylinder, that expansion may take place "isothermally"? Yet I will venture to say that there is hardly an engineer in charge of an engine who does not know very well that the temperature of saturated steam depends simply and solely upon its pressure, and that if the latter varies the former varies with it. Steam expands isothermally in a boiler when being formed, but in an engine, never. The origin of this laxity of statement is simple. We are first taught the fundamental laws of imaginary perfect gases, and then, without modification or warning, we are told to apply these laws to saturated steam. While it is most essential to study the thermodynamics of perfect gases and reversible cycles, yet there is great danger and misunderstanding in applying the results directly to saturated vapors and irreversible charges.

Again, we are all familiar with the dangers of empirical rules. The laws governing the proportions of a detail in a machine are often so complicated that it is exceedingly convenient and useful to apply an approximate formula which will, under the given conditions and within the limits required, answer with quite reasonable accuracy a more complicated and unwieldy mathematical expression. Yet apply this empirical rule to other conditions and outside the limits for which it was intended and the result is absurd. On the one hand it may mean risk and danger to life and property, and, on the other, it may mean that the part so proportioned—or *dis*-proportioned—is ridiculously heavy and unnecessarily costly.

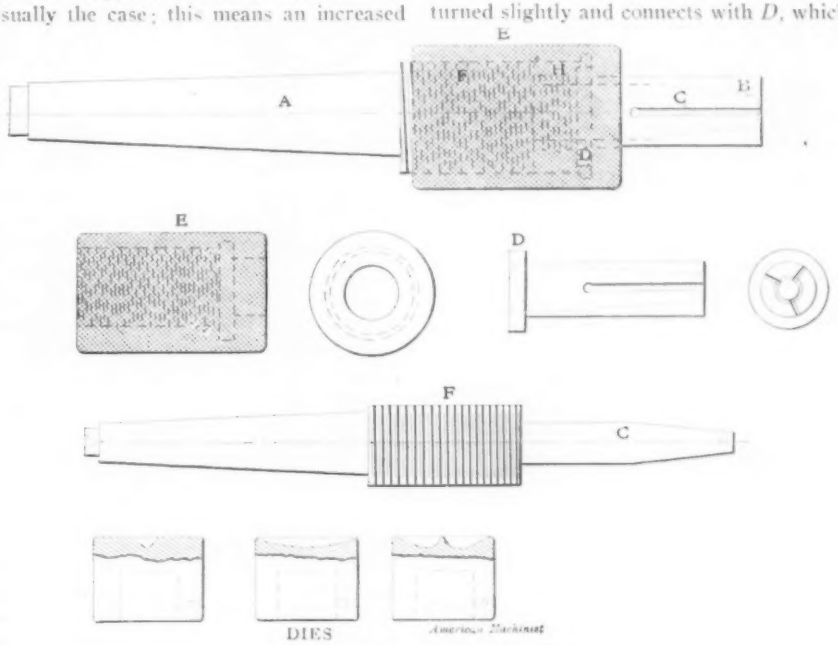
As an instance of the misapplication of rules of thumb may be mentioned the sizes of air pumps for surface condensers. One very common rule is to make the displacement of the pump a certain proportion of the volume of the low-pressure cylinder. Now, there is no doubt that if the initial pressure varied but slightly, that if the number of stages of expansion be the same, and above all if the terminal pressure be constant, that such a rule would yield fairly good results. But what happens if, say, the terminal pressure varies much? Suppose that it be less than is usually the case; this means an increased volume of the low-pressure cylinder to allow of a greater expansion to take place, and consequently, by the rule, a larger air pump. But a lower terminal pressure means more work per pound of steam; hence we have the anomaly of a reduced steam consumption requiring a larger air pump. In this case the correct method of determining the pump displacement from the steam consumption of the engine gives way to the empirical rule of low-pressure cylinder volume, because of the difficulty which existed years ago of saying within a reasonable degree of accuracy what the steam consumption of the engine really was. There are nowadays no valid reasons for this excuse; the designer of an engine ought to estimate within a pound, if not within half a pound, what the amount of water likely to be used per horse-power per hour by the engine under the given conditions will be. That it actually pays to have this knowledge follows from the fact that the pump should be no larger than what is required to maintain the specified vacuum. Any increased capacity is a waste of money, any less a danger of failure and therefore equally a waste of money.

ERNEST R. BRIGGS.

Rugby, England.

Chuck for Holding Small Dies.

The illustration shows a handy chuck for holding the dies shown while being polished. These dies had to be polished all over with a very smooth finish on the face. To polish them in the ordinary speed lathe chuck would take too much time. As we made a large variety of these dies it warranted us making a special chuck. *A* fits the spindle of the speed lathe. *B* is a taper sleeve to fit *C*, and has a shoulder *D*. *E* is a nurled sleeve which passes over *B* and connects with shoulder *D*, and screws up on *F*. A die is placed on *B*, then *E* is turned slightly and connects with *D*, which expands *B* sufficiently to hold the die. When the die has been polished, a slight opening of *E* allows *B* to contract so that the die can be taken off. *H* is a spring which assists *B* in releasing more readily. *B* has three slots.



CHUCK FOR HOLDING SMALL DIES.

PATRICK J. KING.

A Simple Foundry Order System.

I have just noticed my letter on "A Simple Foundry Order System" at page 1670, Vol. 27, and think your reviser of manuscript must have handled it on his "off" day.

I did not state that Mr. Beede referred to *my* system as being "somewhat beyond the loose-leaf-of-scrap-paper stage of development," but to *his own*, as the balance of the sentence clearly shows.

Also, I stated "*all of* the patterns," etc., and not "*off all*," as it is rendered. So you see that by your usual accuracy you have spoiled your readers and made them hypercritical. In this case, however, it is

more or less of an injustice to the gentleman on whose article I commented.

CORNEIL RIDDERHOF.

Spacing Holes in Large Rings.

Having several ring-shaped drill jigs to make varying in diameter from 6 to 8 feet and having from ten to fourteen holes in each, the question was, how could we space the bushings to secure a practically perfect division which in this case would mean a limit of .001 inch.

To lay off by lines was too accidental, the "button" method impracticable, so we adopted a combination "button-bush" plan that gave good results.

Fig. 1 shows a section of one of the rings. They were about 4 inches wide by 1¼ inches thick. The holes to be drilled were 1¼ inches diameter.

Fig. 2 shows the locating bushings of gray iron. The holes in these are the same size as the outside diameter of the bushings in the ring. They are about 1 inch long and large enough for two screws and two dowel pins to pass thru lengthwise. The holes in these were reamed and the outsides finished uniformly on a grinder. The ring was then laid out approximately correct and these bushings placed

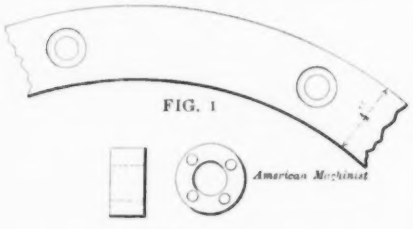


FIG. 2
SECTION OF JIG AND GRAY-IRON LOCATING BUSHING.

on the face, the same as locating buttons. The holes for the screws were laid off and drilled in the ring, the locating bushings held by the two screws, and, after rapping to exact position, they were finally secured by dowel pins to prevent movement when drilling and reaming.

It is necessary to make as many bushings as there are holes to avoid a final variance in the last space, due to sense of touch, or rather, the lack of it. The chord from center to center can be readily obtained, plus the diameter of bushing; this gives the distance to set verniers, and the outer edge of the ring furnishes a measuring point for the radial distance.

A starting drill, roughing drill, and rose reamer complete the outfit for drilling and reaming the holes in the ring ready to receive the hardened bushings. The holes left by screws and dowel can be plugged if desired.

After all the holes in the ring are finished, it is tested by plugs for accuracy, as porous spots in the iron may cause even a close-fitting rose reamer to crowd appreciably; this must be corrected by scraping. However, work of this size seldom needs the exactness required on smaller fixtures and usually the holes will be within permissible limit.

A. B. C.

Peterboro, Ont.

The Accident to the "St. Louis."

I read the article by Amos Price at page 1,571, and tho he condemns the practise of guessing at the "safe tightening limit" and makes a few remarks on stresses, he suggests no remedy or improvement on the guessing system.

Marine engineers are always willing to receive advice or "pointers," and, as a marine engineer, I am sure a little edification on this point would be very acceptable. I have no method to suggest, but use my own judgment in the matter when tightening bottom end or other large nuts, and consider that when the sound of the hammering changes from a dull thud to a ringing blow the nut is tight enough; at this point you will find that the nut has stopped moving, and the nut and bolt are as nearly solid as necessary.

I have had chiefs who would shake their heads dubiously when I said, "Tight enough!" and say: "Just give her another couple of taps"; and others who would ask me if I wanted to break the wrench. But "better sure than sorry" is a good motto to always bear in mind. I don't wish to criticize the workmanship of the shore engineer, but must say that some of the methods adopted in Youngstown, Ohio, are, to speak kindly, crude. Imagine rust-binding the thread on a piston rod nut (!), especially when one never knows the day it will be wanted off in a hurry. Might as well get a riveting hammer and spread out the exposed thread on, and the end of, the rod. Suppose that engineer had tried the "awkward" marine engineer's method, and fitted a check-plate on the crosshead, binding the nut, as in accompanying sketch; this would not only have prevented any tendency to slacken off on the part of the nut but could have been removed in a few minutes. I have never known this to fail.

As we are on the subject of bottom-end bolts, I may mention that these bolts always have the fine-pitched thread, the nut has a "spigot" about 1½ inches deep, fitting into a recess in the butt of the rod, and a set screw in the rod tightened on the spigot further secures the nut. There is always a split-pin thru the end of the bolt. As I have usually found the nut slack when once it has been moved with the hammer it goes to show that the bolt is not strained.

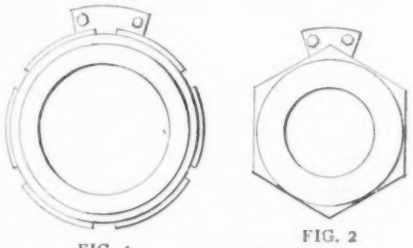
Mr. Price says that Figure No. 2 is not intended to be an exaggeration, in which case we take it for granted that the thread seen in the section of nut, tho much smaller than the thread of the bolt, is merely a slight error in draughtsmanship; a bolt or stud usually giving way on the threaded part below the nut, but the thread in the nut remains intact, if they were a good fit originally.

In my eight years' sea experience in all sorts of ships, from a little two-legged job to twin screws of various types, I must say I have never seen a bottom end like unto that in Mr. Price's sketch.

We had a one-legged pumping engine with a wedged bottom end, on one ship (since sunk), and the only way we could adjust it was to take the top end adrift and swing the connecting rod on the pin, meanwhile turning the crank around to see she didn't bind on the quarters. But I am afraid there would be drawbacks to this method of overhauling a pin on a steamer the size of the "St. Louis," which, I understand, has a crank pin 22 inches in diameter and a connecting rod about 12 feet long.

I can't see how we can remove the wedges if necessary, without taking the bolts right out, or lowering the bottom end into the crank pit. Perhaps the engineer on this particular bottom end, like the one who overhauled our pump, could lift the crankshaft into a vise to facilitate the work. As I don't see how it is possible to take leads off this wedged bottom end, there must be a lot of guesswork in adjusting it—which is bad.

I am a firm believer in solid flat sur-



"TWIN SCREW" PISTON ROD NUT. ORDINARY HEXAGON NUT WITH "CHECK PLATE" IN POSITION.

faces when exposed to a crushing stress, and the inclined surfaces of the wedge are the principal objection to this bottom end shown. The directions for adjustment are vague and unsatisfactory, no means of securing the nut if it accidently slacks back on the bolt, and I finally hope that I never have to steam a few thousand miles in dirty weather with the engines racing heavily, and this type of bottom end fitted to our "old box o' tricks."

Yes, Amos Price, these afloat people do their work in an awkward manner, but, like the Icelanders eating moss for a meal, it is the fault of their surroundings, and only proves their ability to adapt themselves to circumstances.

An English duke once designed a yacht, and overruled any suggestions on the part of the builder as to alterations or improvements. When she was completed, and he was asked how the engineers would manage to overhaul the condenser, he said, quite seriously: "Oh, *they'll* manage somehow, you'll see!"

This is one of the few things we are proud of, as a body—the ability, sometimes

in the face of heavy odds, to "manage somehow." X. Y. Ezee.

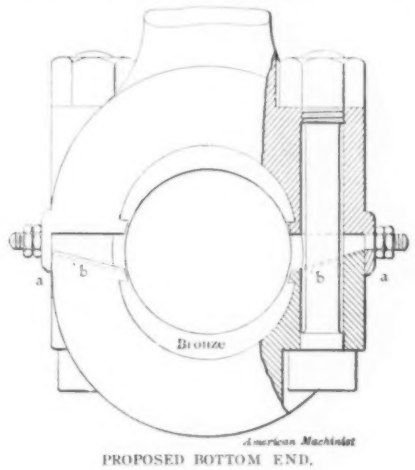
At page 1571 "one" Amos Price bemoans the awkwardness of marine engineers and extols the many virtues of a proposed "bottom end" for large engines. Some few years ago I happened to be one of the "guarantee" engineers on a 5,000-ton job out of Liverpool that was fitted out with this identical scheme on her bottom ends. All the engine-room staff, before leaving port for The Platte, had concluded that the days of stripping and closing bottom ends were over. The first few days out things naturally ran warm owing to the newness of the job, but the bottom ends instead of getting better rapidly got worse, till finally one night those of us above were awakened by the engines stopping. Hurrying below, I was just in time to hear the Chief ask Parks, the Second, the trouble, receiving the reply, "Just doing a little nickel plating"—the babbitt of the intermediate crank pin being all thrown over the plates and condenser wall. I think Mr. Price would have a higher opinion of the "people afloat" if he could have seen us relining that bottom end in a heavy sea way. I have met more ingenuity afloat than ashore.

To get back to the bottom end, we found all our troubles to originate in the wedges which Mr. Price proposes; they having a cheerful habit of jarring loose and giving to the strain of the bolt. Sometimes one end only would give, thereby canting the lower half and causing a hot pin. Again, the studs that held the wedge in place would nip off, causing stops for renewals, etc. Upon waddling into port we took all the bottom ends to the shop and had the bevel faces planed straight and liners riveted in place; on the run home we had no further trouble. I should be inclined to agree with Dixie in that the bottom end bolt of the "St. Louis" was not overstrained, but that the failure was perhaps due to the face of nut or rod being inclined slightly out of square, thereby setting up transverse strains in the threads of bolt.

G. H. J.

Dixie's letter at page 1671, Vol. 27, makes it pertinent to criticise the attitude of engineers and others who, I believe, have mistaken ideas in regard to tightening bolts. It is equally possible to "pat" plate glass with a 56-pound pneumatic faced sledge without injury, and to smash it with a tack hammer. In tightening nuts on bolts with a wrench and sledge, it is of the first importance to know whether the wrench absorbs or transmits the force of the blow. For sledge tightening, the elasticity of the wrench is equally or more important than its length. It must be remembered that the strength of a wrench varies directly as its length, while its elasticity as the cube of its length. With a suitable 12-inch wrench and 56-pound hammer, I feel safe in saying that a ruinous strain can be put on 5¼-inch bolts. At all events, a more rational method of tightening the nuts on these bolts is called for. The popular belief that "you can't get the nuts too tight" ought to be discarded. Even if overtightening does not cause rupture, it often makes trouble in getting the work apart, and in the case of rod bolts the elasticity of the liners adds an unnecessary strain on them, which is always objectionable.

One of *Power's* correspondents (November, 1904, page 667) says that brine is so cheap that marine engineers use it as a lubricant and that the engines soon become so fond of it that they won't run well without it. Now I do not believe that the salt liquor habit is chargeable to the engine builders, for it does not make any difference to the engine, whether it twists a screw or armature, nor is there any marked distinguishing characteristic that could develop so strange a difference in taste for lubricants between land and sea recipro-engines. Clearly, it is time to put some land engineers afloat, who know how to oil and adjust engines. I should



PROPOSED BOTTOM END.

have stated before this that the accident to the "St. Louis" is not attributable to any one afloat, and had Dixie stated in his first letter that there was a flaw in the bolt it is probable that I should have read it only as interesting news, and not referred to it at all.

I beg to submit a bottom end, shown in the illustration, that is easy to adjust, will run with a minimum quantity of oil, will only get a few degrees warmer than the atmosphere surrounding it when running, and will only need adjusting, when in active service, once a year. The body of rod bolts are reduced to give them elasticity, the rod hooks over the cap at *a*, and the wedges are tongue and grooved at *b*, to prevent their tendency to twist.

My thanks are extended to Dixie for his invitation, and to the editor of the American Machinist for transmitting it. I gladly accept. Amos Price.

Dimensions on Drawings.

At page 1707, Vol. 27, Sutram tries to show that he disagrees with me as to the dimensioning of a certain stud. I am willing to agree with him, looking at the matter from a jobbing shop point of view as he does, but I have been writing about making these parts on a Jones & Lamson machine and, I think, have given your readers reason to infer, in large quantities. On the other hand, he is writing about making one stud.

I fully agree with him that the general run of men who can hold down such jobs are capable of independent thought, and I realize it from a number of years' experience with such work. So complete confidence do I have in such men that I should, and did for a long time, give them assembly drawings with a fair allowance of dimensions and very few detail drawings. In this case there would undoubtedly be other parts of the machine to which to fit all parts of this stud, and about the only use that the jobbing shop man would make of a drawing would be to get the size and length of stock from which to make it.

In such shops as we are now speaking of a micrometer caliper, which is supposed to be used with the drawing which I showed, is an ornament, or a luxury, used chiefly to impress the foreman and his shopmates with the superior abilities of the owner. Some of the worst workmen I ever knew in jobbing shops sported micrometers like a race-track sport with his glass diamonds, and many of the best didn't know how to read one.

For Sutram's benefit I would like to say that a drawing such as I showed would be out of place in a shop where an under-size reamer is tolerated. It would also be out of place where the same reamer is allowed to be used on both bronze and iron.

So far as fitting nuts to threads is concerned, it would be much better to have hardened gages instead of sample nuts; but they are not in at all common use, while ordinary standard gages are. It is out of the question for a Jones & Lamson hand to stop and fit a nut on every stud, but commercial nuts may be had close enough to standard so that a large number of studs may be safely made with one setting of the die.

"Tight" and "free," as applied to nuts, undoubtedly sound like rather loose expressions, but when we come to consider that more latitude may be allowed in making thread fits than straight fits, as we all know by experience they probably will continue to pass, as they always have since threads have been cut. A little consideration will show why this is so. If the bolt and the nut were of exactly the same pitch, and if the thread angles exactly corresponded, then it might be necessary to use the same care in fitting a nut to a bolt that we use in making a straight fit. But the two threads are not of the same pitch, unless by accident. They consequently bear only on the end threads. The elasticity of the material in the length of the nut allows a nut which really fits

too tight to be screwed on, and this same elasticity keeps this nut snug on the bolt till it has worn quite a little, and it also allows considerable latitude in the original fit. If the threads of the nut and bolt are tipped at ever so little an angle to each other, then the bearing comes at the top and bottom of the threads only, and this same elasticity of the material acts in the same way as before to allow more error in fit before perceptible looseness occurs. E. H. FISH.

A Rotary Core Oven.

The oven here illustrated is intended for drying cores of small or medium size such as can readily be handled on core plates. Fig. 1 is an elevation showing the shelving inside by dotted lines. I call it a rotary oven, but the oven proper does not rotate; only the shelves turn. This shelving is built up on a bed ring, a section of which is shown by Fig. 2. This ring has in its upper surface a ball race which carries one-inch steel balls, see Fig. 3. On its outer edge is a flange the outside diameter of which is 5 feet 1¾ inches. The shell forming the oven sets down over this flange, as shown at *A*, Fig. 1. The first shelf is shown by Fig. 4. In the under face of the flange ring *B* a ball race is formed corresponding to the race in the bed ring. This shelf, set on the balls, forms the foundation and carrier for all the shelving, which is the rotating part of the oven.

There are, in all, five shelves. The lower one has an opening in its center 20 inches in diameter, as shown on the plan, Fig. 4. Directly underneath this is placed the oil burner in a cavity formed in the foundation as shown at Fig. 1. By reference to this figure it will be seen that the shelves or disks are marked No. 1 and No. 2, these numbers designating the different castings used. The second and fourth shelves, disk No. 2, are alike, having a cluster of 2-inch holes in the center as shown by Fig. 5. The third and fifth shelves, disk No. 1, are also alike, having no holes in the center, but, instead, the holes are distributed near the circumference, as shown by Fig. 6. By locating these shelves as shown by Fig. 1, the hot air is evenly distributed throughout the oven, as shown by the arrows. The third shelf is provided with a circular rack and on the end of the crankshaft is a small pinion which engages with it. By using the crank the entire stand of shelves can be turned at will. The columns *X* are made of 2-inch pipe with a gray-iron collar on each end. Passing thru these columns, of which there are four sets, there are four ⅞-inch rods firmly holding the entire structure together.

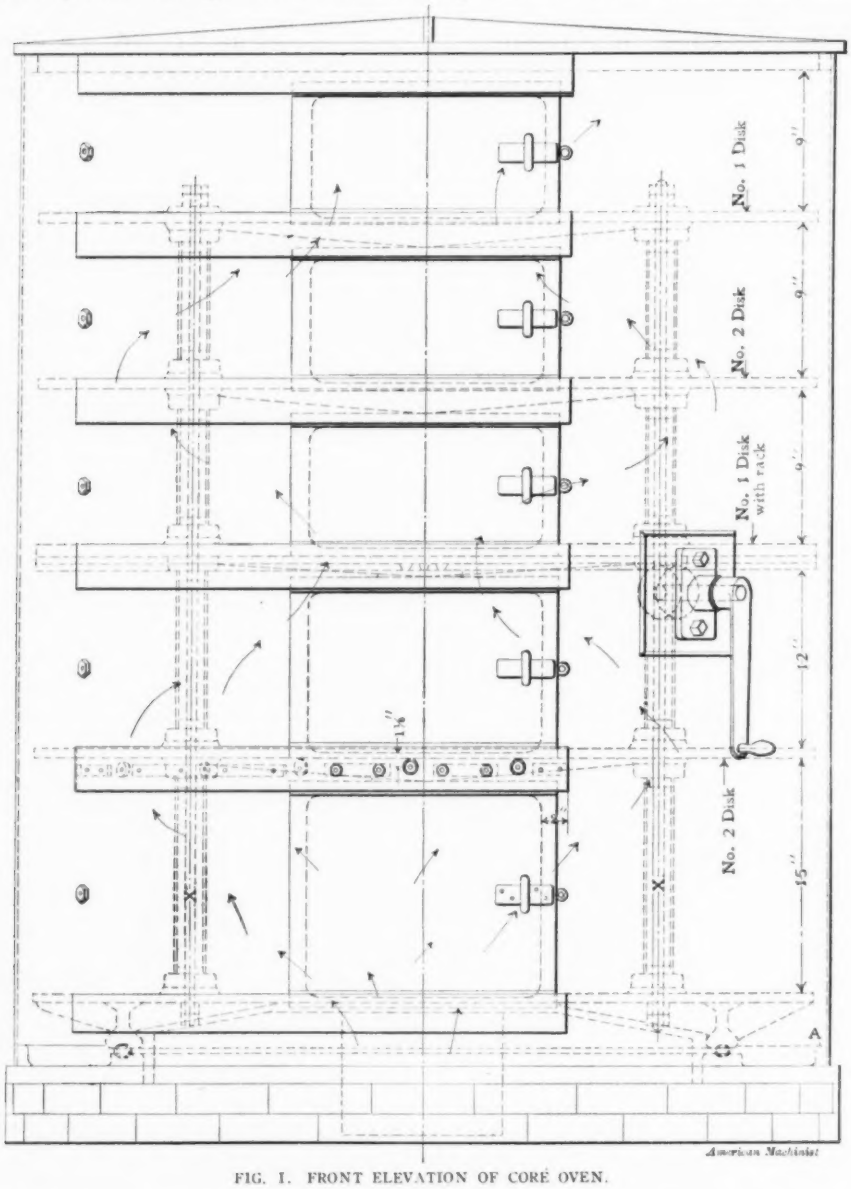


FIG. 1. FRONT ELEVATION OF CORE OVEN.

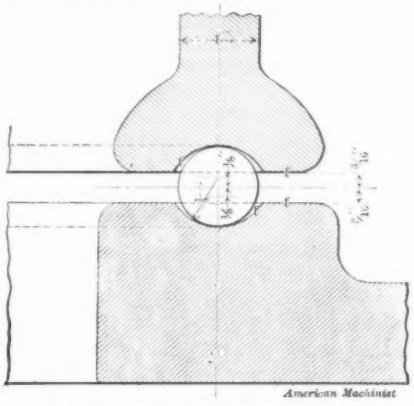


FIG. 2. SECTION THRU BALL RACE.

The doors of the oven, which slide around the shell, are made of boiler plate bent to the radius of the outside of the shell, and are set on rollers in the groove at the bottom. The handle is a forging riveted to the door. On top of the shell is a gray-iron covering plate provided with a few vent holes which can be opened or closed by slides, as found necessary.

This brief description and the accompanying drawings I think will be sufficient to give a full understanding of the oven. There is absolutely nothing about it to get out of order, no hinges to give out, no brick arches to keep renewed. Each revolving shelf has its door, thus enabling cores to be placed in or removed from either shelf, without exposing the others. Using oil for fuel, we have no coal or coke to handle, no ashes or cinders to remove. The fire requires no attention after lighting and the heat can be controlled absolutely. Greater economy, of course, can be obtained by covering the shell with some kind of non-conductor. If heat is needed in the coreroom during the cold months, no better or cheaper source of supply could be found than the oven without covering. B. W. T.

Handling Expanding Mandrels.

At page 1721, Vol. 27, I notice a cut representing an expanding mandrel. The article referring thereto comments as follows: "Nothing is said in the patent about holding the helical bushing endwise while driving in the mandrel."

I have often used expanding mandrels similar to this one, the only difference being that where a helical spring is used in this case, I have used a split bushing in-

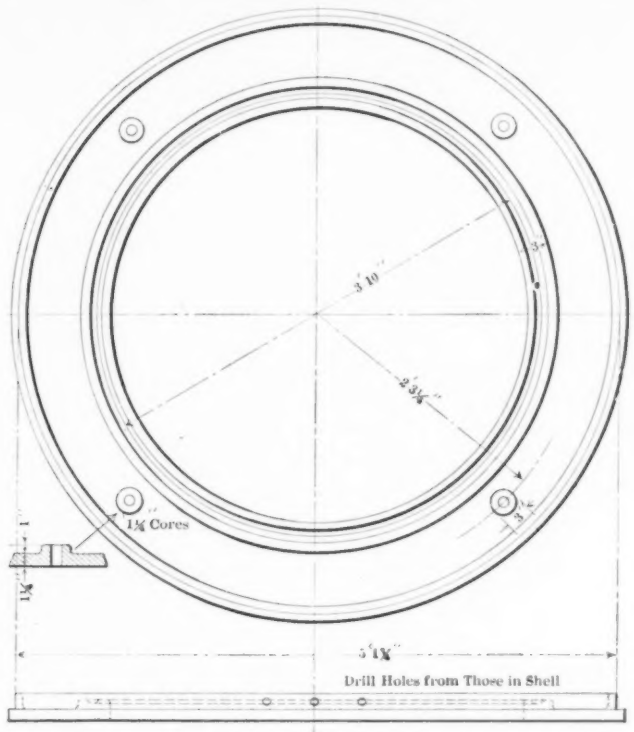


FIG. 3. BASE OF OVEN.

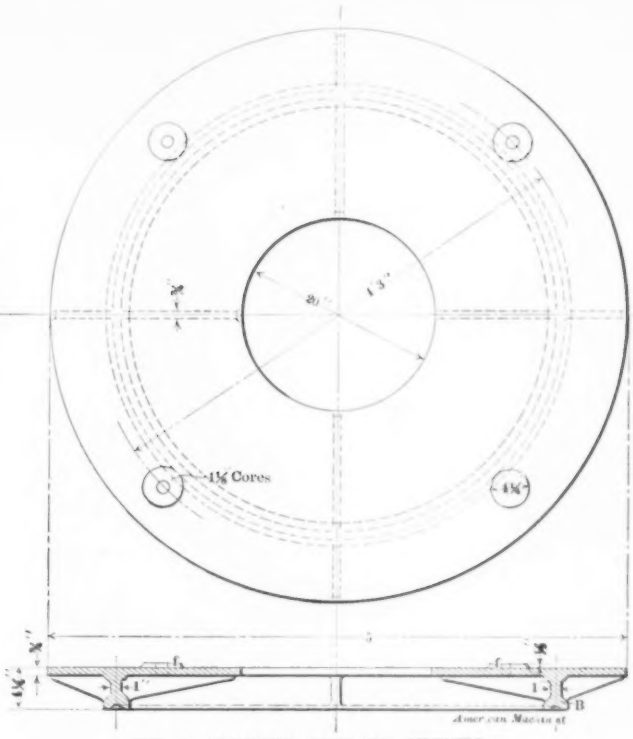


FIG. 4. ROTATING BASE FOR SHELVES.

stead. The split b··shings have been slightly taper on the outside, say about .001 inch taper to 3 inches in length. Of course the bushing had to be held endwise while expanding it to suit the size of the bored hole; but when expanded enough to have a bearing all around when entered into the hole, such all-around bearing would be sufficient to hold the bushing while driving in the mandrel tight. Hence, altho the description referred to states that the bushing is cylindrical on the outside, it seems to me that it must have a taper, tho it be ever so slight; and as for expanding the spring sufficient to just enter the bored hole, that seems very easy of accomplishment by holding the mandrel in a vise, or with a dog between the centers of a lathe, and turning the spring by hand to the right, pushing it up on the mandrel at the same time, the turning to the right and pushing having a tendency to open the spring. R. B. BOONE.

An Automatic Notching Die.

This die is for either the foot or the power press. An operation of this kind was formerly done in the milling machine, and 40 cents per thousand was paid for it. A die of this kind was suggested,

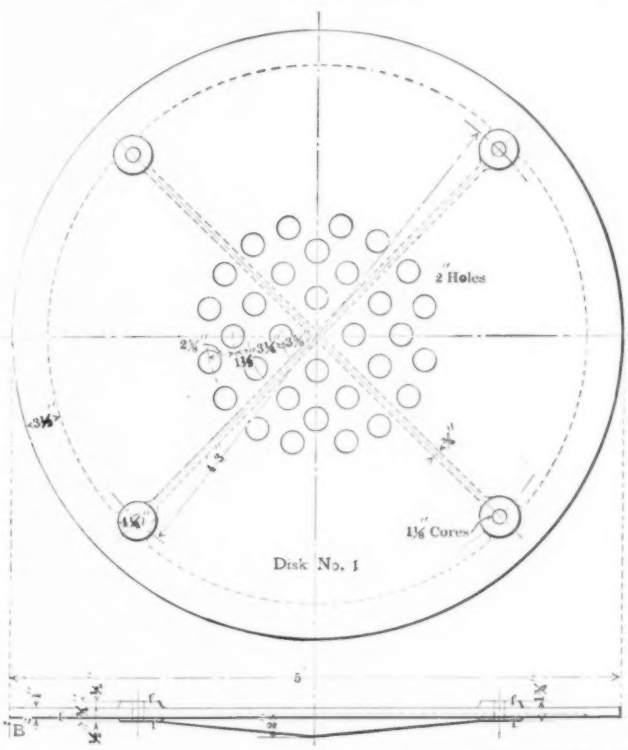


FIG. 5.

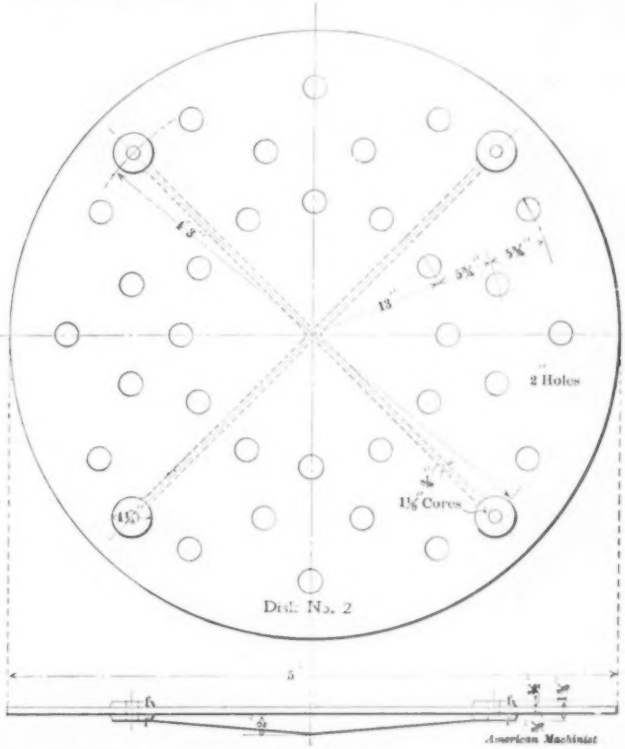
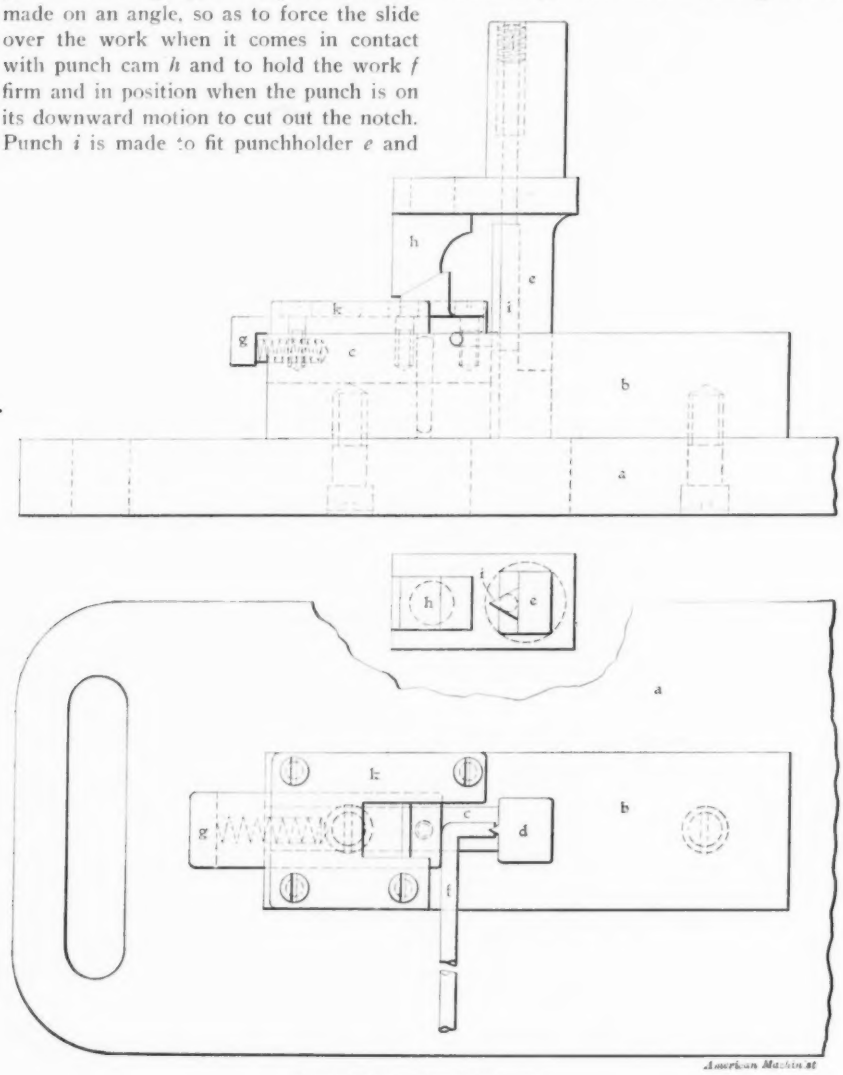


FIG. 6.

ROTATING SHELVES OF CORE OVEN. ONE WITH LUGS ON BOTTOM FACED TO FINISH SURFACE B. ONE WITH SURFACE B NOT FINISHED AND LUGS FACED TO FULL LENGTH. TWO OF THIS.

made and tried; the trial was satisfactory, and now the work is being done at 10 cents per thousand. The operation is the notching of the bent wire *f*.

A is a gray-iron bed on which die-holder *b* is fastened by two screws. Die-holder *b* has a tool-steel piece *c* set in, which is used as a cutting die. The die-holder has a square hole *d* put in as a guide for the lower end of punch-holder *e*. Die-holder *b* and die *c* are worked out to the shape to suit the work *f*, which is gaged by them. Slide clamp *g* has a projection standing up, the top of which is made on an angle, so as to force the slide over the work when it comes in contact with punch cam *h* and to hold the work *f* firm and in position when the punch is on its downward motion to cut out the notch. Punch *i* is made to fit punchholder *e* and



AUTOMATIC NOTCHING DIE.

is adjustable vertically by means of screw *j* in the punch shank, so that when the punch gets dull it can be sharpened and adjusted in same cutting position as before. Cap *k* is to keep slide g in position.

G. J. L.

Metal for Embossing Dies.

I have for some time been waiting to have some of your older contributors answer your English correspondent who signs himself "Foreman" at page 1438, Vol. 27, who wants to draw out from readers who have had experience with embossing dies what mixture they use for making the "force," or, as he calls it, the "male"; how they melt and pour it, etc.

In reply to his request I would say that we have found after a great deal of experimenting and expense that "Bertha" spelter, made by the Bertha Mineral Company, 71 Broadway, New York, has given us better results than any other of the many metals tried, including some we made ourselves, as an experiment.

As to melting and pouring, I will say that we do our melting in a ladle in an ordinary blacksmith's fire, and pour in the usual way, after first warming the die. Great care is taken that no water is around while the pouring is going on.

C. F. EMERSON.

[The manufacturers of the metal above referred to decline to give us any additional information concerning it.—Ed.]

Keeping Ink in the Pen.

The article by "A Draftsman" at page 1405, entitled "Lettering with the Pen," reminds me of a little device I saw used by a tracer. It consists of a piece of soft thin sheet metal cut to the shape of Fig. 1 in the sketch. It should be just as wide at *a* as the pen, and be bent like Fig. 2. The point *b* should be nicely fitted to the under side of the pen, and end about 3-32 inch from the pen point. This forms a pocket which can be filled full of ink, with no danger of dropping. It does not gum

FIG. 1 FIG. 2

American Machinist

TO KEEP INK IN THE PEN.

or clog, as one might suppose it would, but can often be used ten or fifteen minutes without refilling or cleaning, and when it does need cleaning the little retainer can be slipped off, cleaned and replaced in a minute. To those who may try the device I would say, don't be discouraged if it doesn't work well at first, as it is sometimes rather a delicate thing to adjust properly; but once right it works fine.

SKETCH.

"Ring" Center Punch.

I had a job to cut out a great many square holes in heavy sheet iron. The only way I could do the job was to drill ½-inch holes, chip and file to the line. I soon found out that I had a long job before me laying out so many small holes with dividers, so I went about to find an easy way to do the job. The ring center punch, as I called it, is what I made. Fig. 1 shows the punch. With this tool all that is necessary is to lay out the outline of holes to be cut out (see Fig. 2), take the punch and set it close to the line and strike a light blow with a hammer. The punch will make the circle to drill by and mark the center. Then take a large center punch and mark for the drill point to enter. I have a set of these punches of different sizes and I would not be without them. I think any machinist that makes one of these punches will have a set of them in his tool-chest in a very short time. Anyone knows what a time it takes to lay out holes with dividers. With this punch you

FIG. 1

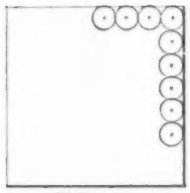


FIG. 2

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THE PUNCH AND THE WORK.

can make the line heavy enough so that you do not have to prick-punch the circle as you do when you use dividers.

H. S. GILLETT.

Halving Mixed Numbers.

Some time ago, while making a drawing, the dimensions for which required a large number of divisions by two, I stumbled

upon a rule the use of which enables one to determine quickly and easily the half values of such numbers as $3\frac{29}{32}$, $5\frac{9}{16}$, $1\frac{57}{64}$, etc. Of course the value of one-half of $1\frac{57}{64}$ is $\frac{121}{128}$, and that of $5\frac{9}{16}$ is $2\frac{25}{32}$, the ordinary way of finding these values being, as almost any schoolboy knows, as follows:

$$\tfrac{1}{2} \text{ of } 1\tfrac{57}{64} = \tfrac{1}{2} \text{ of } \tfrac{121}{64} = \tfrac{121}{128}.$$
$$\tfrac{1}{2} \text{ of } 5\tfrac{9}{16} = \tfrac{1}{2} \text{ of } \tfrac{89}{16} = \tfrac{89}{32} = 2\tfrac{25}{32}.$$

Now, an examination of the fractional parts of these half values shows that the numerator of the fraction is equal to the sum of the numerator and the denominator of the original fraction, while the denominator is twice the original denominator. Thus for one-half of $1\frac{57}{64}$, we have $\frac{121}{128}$, 121 being the sum of 57 and 64 and 128 being twice 64. Likewise for one-half of $5\frac{9}{16}$ we have for the fractional part of the result $\frac{25}{32}$, 25 being the sum of 9 and 16 and 32 being twice 16. The rule for finding the one-half value of any mixed number in which the whole number is odd, is therefore as follows:

Divide the whole number by 2, neglecting the remainder; add the old numerator to the old denominator for the new numerator, and multiply the old denominator by 2 for the new denominator.

It is possible that there are easier and more rapid ways for finding these values, but I have never seen any rule which is quite so convenient for mental calculations as the foregoing. L. A. M.

Making Built-up Crankshafts.

When making a built-up crankshaft, most people turn the crank-pins before putting them in place, leaving a cut to be turned off when all put together.

The old way is to bore all the holes in the disks and to turn the ends of the shafts to fit, shrinking them together by bolting in V-blocks on a level plate to get them

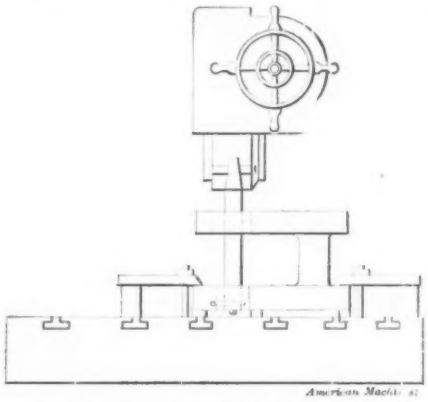

FIG. 1. BORING CRANK DISKS.

in line, and then if the body of the shaft does not run true it throws the crank-pins out of line. The proper way is to first bore the holes in the disks for the crank-pins only (and if it happens to be a double crank to bore the pin holes in both), leaving the holes for the shaft to be bored after the crank-pins have been put in place and then boring the holes for the shaft as in the sketch, boring both holes with the bar without shifting the work. When the shaft is put together it will run almost true, or if it is out at all it will not be enough to throw the crank-pins out of line. MORTIMER PARKER.

Seattle, Wash.

Three Ways of Molding Bed Plates.

There are small things connected with the foundry business that often are not noticed until it is realized that too much

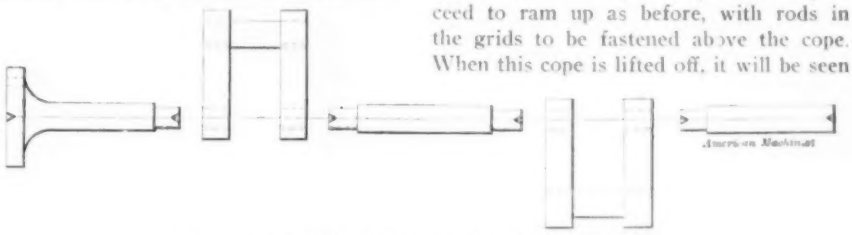

FIG. 2. CRANKSHAFT READY TO SHRINK TOGETHER.

time is spent on a casting. Then the parties in power may look around to find out where the trouble is. I will illustrate where a lot of time and trouble may be saved. We will say that we have a lot of small bed plates to make, about 5x8 feet and 1 foot deep. There are a great many made about that size, and there are several ways to make them, as I will show.

PLAN NO. 1.

One way is to dig out a hole in the floor and level a bed large enough for the pattern. The general run of these patterns are very near flat on the bottom, as the boxes for the bearings are bolted on afterward. I am not going into the details of the making of the bed, as that is very well known to molders who would be given a job like this. Lay the pattern on the bed and press it down a little to make the impression of the core prints and any other pieces that may project. Lift off the pattern and cut out enough sand to allow the pattern to go down level; then replace it and knock it down with a good-sized block across it and a heavy sledge. A light sledge will do more harm than good. Take the pattern up again, nail the sharp corners and finish as much as can be done, as it is more easily done with the side open than after the mold is rammed up. After the pattern is replaced ram up to the joint as usual.

There are a lot of pockets to be lifted out of this pattern, so that we must either make gray-iron grids or put chucks in the flasks so that we can use gaggers. The grids can be made in a bed, getting the different measurements and cutting them out with a gate cutter. Cast two nuts or more in each according to the requirements; get bolts that will reach about two inches above the bars of the cope to be fastened to cross-bars to lift the cores. When the cope is rammed up, lift off and block it up high enough to allow a man to work under it; then will be seen the amount of work that is to be done, patching up the cores and nailing it here and there.

PLAN NO. 2.

The same routine as in the former case may be carried out up to the joint of the bottom part. Then take the measurements of the cores to be lifted out and make grids as described in plan No. 1. Now, get some strips and make core boxes about two inches deep and bed the grids in them. When these cores are dry put them into their respective places and proceed to ram up as before, with rods in the grids to be fastened above the cope. When this cope is lifted off, it will be seen that there is not much finishing to be done, as the dry sand cores do not break away as with the green sand, but come up nice and square and save a lot of time patching up, more than will cover the time of making the cores, as they are only flat cores that any boy could make.

PLAN NO. 3.

With this plan the pattern is put on a board and rolled over, providing you have a flask that you can roll it over in. Get your board down and put the pattern on. Now find out where the cores are, or about where they come. The best way to do this would be to raise the pattern on its side and mark where the bottoms of the cores are, so that it can be seen when the pattern is on the board. Now get some flat cores about an inch thick and as large other ways as is requisite. These flat cores are for holding the studs, otherwise if they were put on to the green sand they would sink in. It must be understood that these molds are all made in green sand.

The cores are made from the pattern. The best way would be to take one side of the pattern—that is, one side of the cores, as one long plate would cover the lot—then take the end ones. By this way of making them the cope can be rammed up on a plain board, as there is nothing in the cope of most of these castings; then all that is to be done is to put your studs on the flat cores on the bottom place and divide the cores. Mind that the cores bear well on the cope or there will be danger of their washing away.

Now here are three ways to make these beds illustrated, so that those who have a job something like it can pick out which method they think is best. For my part, I think plan No. 2 is best, unless there are separate core boxes made for plan No. 3. A good way to fasten these cores in the mold is to have some hoop iron about one inch or one and a half inches bent in the form of a U and then pressed down between the cores; that will hold them all solid together. THOS. WATHEY.

An Adjustable Taper Gage.

Having had a great many tapers to fit, such as piston rods, propellers, shafts, etc., I devised the tool Fig. 1, and find it a great saver of time and patience. In Fig. 1, *A A* are straight-edges, *B* is one of the eight arms forming the adjustable trusses, secured at *a* by nurled nuts engaging studs set in the straight-edge. The joints at *b* are ordinary caliper joints and at b^1 the rivet goes thru the straight-edge. To open the gage pull the joints at *b* in the direction of the arrows. It requires considerable pressure on the straight-edge to move it, which is a good feature, as when it is locked it is very rigid. The graduations are not necessary, but facilitate calipering.

I find it much easier to set the gage to a hole (and then use outside calipers for turning a shaft) than to use inside calipers and transfer, as you then have a duplicate taper right at your lathe, with very little danger of shifting, as is the case with calipers.

Fig. 2 consists of straight-edges *A A* and cross-pieces *B B* locked with nurled nuts, and is used in conjunction with Fig. 1 for making templets. Take No. 1 gage (down on the dock or wherever the job may be) and set to the hole, noting the depth by graduations, return to the shop and set No. 2 outside; you then have a duplicate hole, and by the use of a little

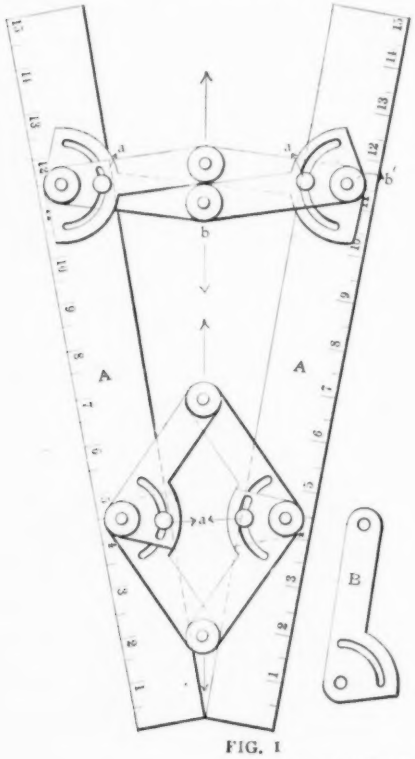

FIG. 1

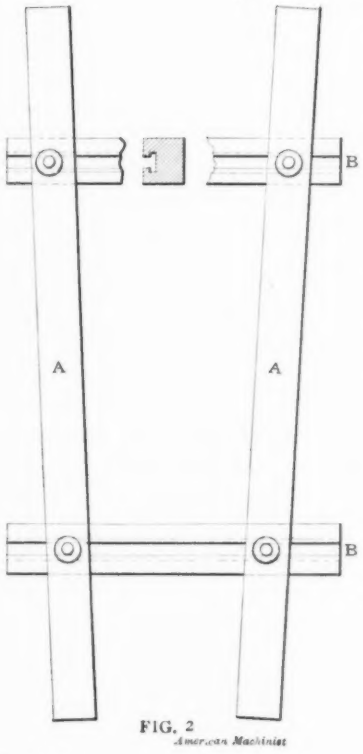

FIG. 2

AN ADJUSTABLE TAPER GAGE.

red marking can make an accurate templet. In the meantime No. 1 gage can be used to fit the shaft or bore to. The gage can be made for any size hole from 1½ inches up, tho one for a 1½-inch hole is rather frail for anything over 6 inches, one for a 4-inch hole is rigid enough for a 18-inch hole.

A. S. MACKENZIE.

Drill Jig and Holder.

The drawing, Fig. 1, shows the section of a bearing with which I had considerable trouble in drilling the two small holes until the jig, Fig. 2, and holder, Fig. 3, were made. The lower end of the jig is bored and has a taper plug fitted which is tightened when in position by means of the screw. The holder is simply a V-block held at the necessary angle.

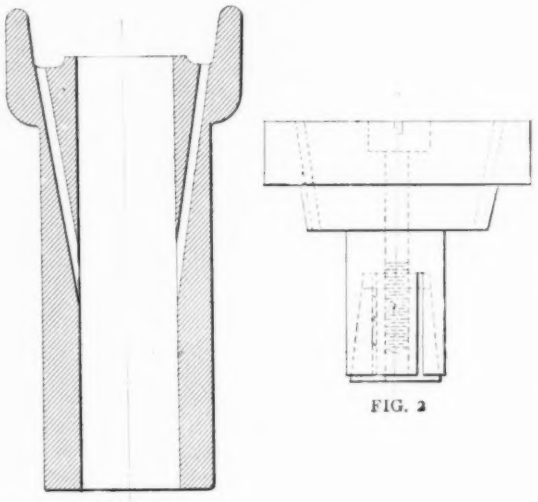

FIG. 1

FIG. 2

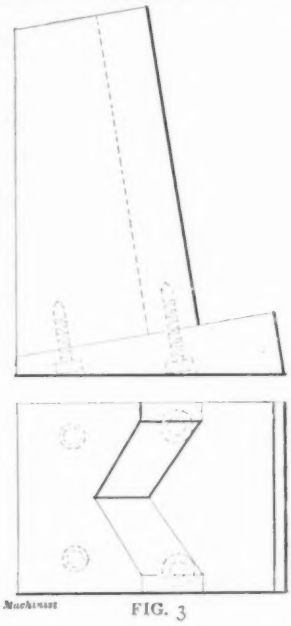

FIG. 3

A DRILL JIG AND HOLDER.

RHODERICK DHU.

Lathe Spindles Running in Solid Boxes.

There was once a settled idea that a bearing and a shaft or spindle running together must necessarily wear out. Lately there seems to be a tendency to admit that under favorable conditions and ample lubrication it is possible to keep the surfaces out of actual contact and have only the oil wear out.

I wish to relate something that would probably have been regarded as a "fish story" at the time, tho it is an actual occurrence and fits in perfectly with our present ideas.

We put two new 14-inch lathes into the shop to use. They were of our own make and standard in every way, except that in place of split bronze or composition bearings for the main spindle we put in solid cast iron boxes. These were straight bearings, 2⅜x3¼ inches and 1⅞x3 inches, without any means of taking up wear. The spindles were of crucible steel forgings, supposedly about 40 points carbon, possibly a little more, but were annealed before turning and left so. The two lathes were put in next to the setting-up floor and were run by anyone, boy or man, who came along. No one had any care or responsibility for them.

Our foreman, of course, kindly explained to me that they would need new split boxes as soon as they wore to a bearing. This was the last I heard of them, till one day, almost seven years afterward, when this same foreman came into the office one day and asked me if I knew that those two 14-inch lathes had solid boxes. Investigation showed, after tightening the boxes in their seats, that there was no appreciable play in the spindles. About a year later these lathes, pretty well worn in other ways, were sold. I do not know what has become of them now, but I think that this experience shows that a bearing which cannot be monkeyed with has as good a show for long life as a man who can't afford to pay doctors' bills.

E. H. FISH.

Worcester Polytechnic Institute.

A Portable Worm Driven Boring Machine.

The sketches show a portable boring machine, very cheap to make and capable of doing accurate work which is sometimes performed on machines costing nearly ten times the amount of money. We find it profitable to keep four of these machines almost continually employed, two of these operating chiefly on Corliss valve seatings, both on the same cylinder, one machine at each end. In such cases one man can easily mind two machines on a large surface plate on the shop floor where the cylinders are bored, the machines being brought to the cylinders. We also use one in the same manner to bore out the main crank shaft bearing on the engine bed for large Corliss engines up to 3,000 horse-power. The other one we chiefly use for outside work, reboring Corliss valve seatings, etc., driven by a small engine and countershaft in such cases.

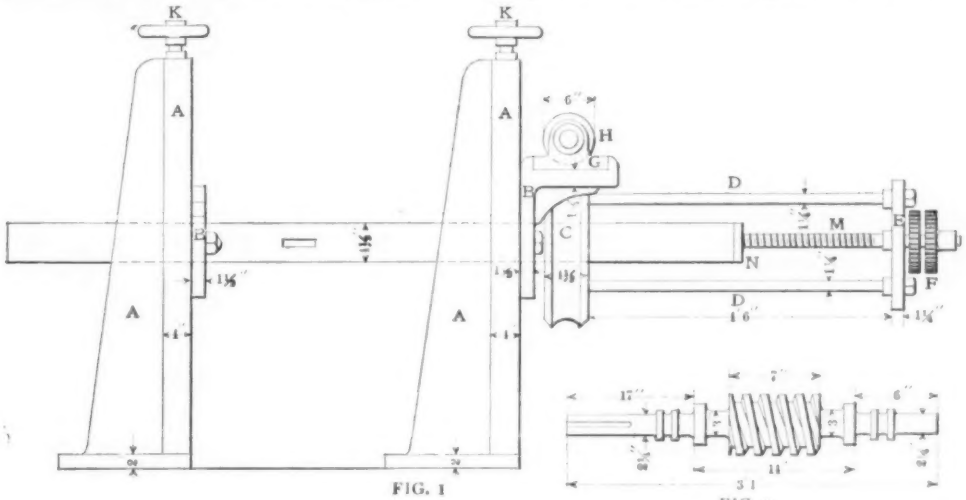

FIG. 1 FIG. 7

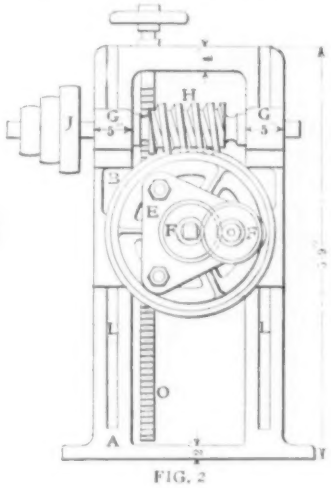

FIG. 2

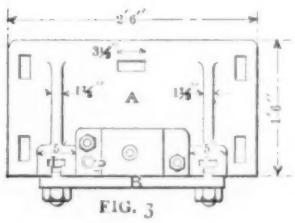

FIG. 3

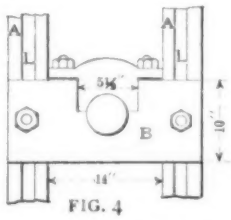

FIG. 4

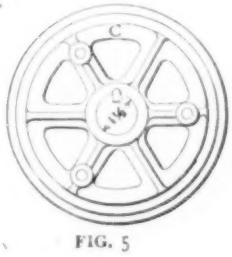

FIG. 5

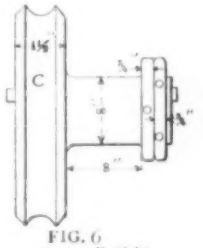

FIG. 6

A PORTABLE WORM-DRIVEN BORING MACHINE.

In Figs. 1 and 2 *A A* are two gray-iron standards exactly alike, planed on the bottom and front, and also on the inside faces, into which the carriages *B* are made a nice sliding fit. The carriages are bored out to carry the boring bar, which is 4½ inches diameter, as shown in Fig. 1. The two bolts fitting in the tee-slots *L* on the front of the standards clamp the carriages in position when set. The hand-wheels *K* raise and lower the carriages thru the screws *O* working in a nut in *B*, shown in Fig. 3 at *P*. The worm *H*, shown also in Fig. 7, with thrust collars, is turned out of mild steel, being 6 inches diameter over the worm, which has a double lead, 1¼-inch pitch, case-hardened, supported by the two bearings *G*, with caps 5 inches wide and gun-metal bushes bored out to receive the thrust collars. The worm-wheel *C* is made of gray iron, with fifty-five teeth, and has a long boss cast on as shown in Fig. 6, 8 inches diameter, with a thread cut on the back end and two lock nuts which keep the worm-wheel firmly in position in the carriage *B*. The boss is bored out 4½ inches diameter to carry the boring bar, which it drives by a key ½ inch wide sunk in the boss of the wheel and kept in position by a small peg at each end, passing thru the head and into the wheel boss, the boring bar being splined the whole length. The three small bosses shown at the outer extremity of the arms in Fig. 5 are tapped 1 inch diameter and carry the three supporting stays *D*, which support the end plate *E* for carrying the feed gear wheels *F*, which are of the ordinary "sun and planet" type, the square boss on the outside of the central pinion being for a handle and also to keep the screw stationary for drawing the bar back by power.

The boring bar is 10 feet long and is bored out for a distance of 5 feet to clear the top of the thread on the feed screw *M*, which feeds the bar thru the brass nut *N* fastened to the end of the bar by three screws ½ inch diameter and having a square thread with six threads per inch. The cotter hole in the bar is for carrying the boring cutters, which are either held by wedges or set-screws, as desired. The machine has a three-coned driving pulley *J*, which is driven from an overhead countershaft, when used in the shops, placed in a convenient position, the shaft having a keybed cut the whole length to allow the driving cone pulley to be moved along the shaft to suit the position of the boring machine, which varies somewhat according to the work in hand. J. GREEN.

England.

I have seen a man spend more time and do more damage to his work trying to drive one crooked nail which had been "saved" than would have bought several pounds of good straight ones at the present prices. Ben Franklin's old saw was doubtless a good one, but *no saw will run forever without filing;* and, tho "a penny saved is a penny earned," it is sometimes cheaper to earn the penny than to save it. —*Wood Worker.*

As the superintendent escorted his visitor leisurely thru his great plant, the visitor thought to himself, "This superintendent has a snap," and he finally ventured to ask the question, "What is the hardest thing you have ever had to do in connection with this plant?" To which the genial superintendent replied, "Well, I'll tell you, the hardest thing I ever had to do in connection with this plant was to get the job." —*Textile World.*

At the New England cotton mills a "mill power" is about 86 horse-power, and at Minneapolis it is 75 horse-power.

A Plea for Breadth of Culture in the Technical School.*

The other speakers to-day are presidents of colleges, educators of wide experience and national reputation, and it savors of rashness for me in their presence to venture opinions upon the aims and methods of a technical school; but during my twenty-five years of taking on technical graduates in almost every year and trying thru them to keep in touch with the schools, I have often found what has seemed to me a misapprehension among students, friends and patrons of technical schools, that to an audience of friends and patrons a few words from the standpoint of a business man and practising engineer may have some interest.

Why do we not find the greatest prizes of the industrial works and of civic administration going *more* often to the technical graduate? Why does the commercial department pay better salaries than the engineering department? We have all seen plenty of examples that prove that technical training is of itself an aid rather than a bar to commercial success.

Have our men got too narrow a training in the technical school?

Within the past week I have chanced to hear two heads of great concerns, each employing many scientific men, say, in substance, that the old academic education fits better for the position where one deals with men, or for the $10,000 position, while the technical school fits better for the position that deals with materials, or for the $4,000 position, and I note that sons of my old classmates are being sent first to Harvard or Yale or Dartmouth for *four* years and then to "Technology" for a *two* years' course in science.

Six years time—from eighteen to twenty-four—is more than the average young man can afford to spend at school. It brings him into the works too late. When we more fully appreciate that *education, rather than information,* is the true aim of the technical school, then a broad education and sufficient information can both be given in a four years' course.

Can we not give a better education to the great majority of our students and plant in them thirst for information by doing fewer things more profoundly and putting more emphasis on the personal element?

Is not the one great captain of science or industry, like Pasteur, Kelvin, Ericsson, Bessemer, Westinghouse, Mills, Brush or Alexander Brown, and a hundred others, worth more to his country and his neighborhood than a room-full of the very necessary and useful sergeants and corporals of science and industry?

Cannot our school do the most good and best serve all, and best stimulate the ambition of all, by trying to fit men for the position of captains; and if the man skilled in the applications of science has also executive skill and such knowledge of men that he can negotiate, convince and arouse men, will not he have a wider opportunity to do good and to advance the state of that art and the public welfare; and shall we not by addressing our teaching to the highest grade thus produce more of the $10,000 men and at the same time better $4,000 men?

In separating students into many courses, is there not danger of splitting things too fine? Have we not gone too far in specializing for the undergraduate?

It is a matter of slight importance to the machine builder whether he takes the course in mechanical engineering, civil engineering or general physics, if he is fortunate in his teacher.

The chief function of the technical school is not the filling of a man's memory with formulas and with knowledge of how everything is made, but rather is the training in methods of thoughtful research, of teaching how to put the question and where and how to find the answer, of how to set traps for his own unconscious errors, how to save time by understanding just what degree of precision is necessary to the case in hand, how to measure with certainty the limits of the ever-present error, and above all to develop and strengthen a warm, enthusiastic, undeviating love for the truth.

In my own college days I did not have it made plain, and I failed to grasp the fact that perhaps the greatest opportunity of college life is that of coming to better know one's fellowmen, and it is in failure to appreciate this more than in any other one feature that the professional school has failed in comparison with the older colleges. In the protest against the old education, exemplified in the early development of the Massachusetts Institute of Technology and other similar schools, the pendulum swung beyond the center and the value of the social idea was for a time not appreciated, and to many of us there was lost the inspiration and broadening, the deeper understanding of humanity that may come from entering into the daily life of the ancient civilizations enough to understand that human nature is much the same thru three thousand years. We missed that focusing and sharpening of the wits which comes from taking time for the discussion of current events with our fellows.

One of our professors read to his class Holmes' verses on the Deacon's Masterpiece, "equally strong in every part," as typifying the ideal machine. McAndrew's hymn may teach a deeper lesson. The young man should be led to find inspiration in his machinery while in the technical school.

A few weeks ago, in Chicago, I sat beside a classmate, a former "grind," now a successful man of business, at a gathering of the graduates of one of our largest technical schools. Said he: "We were brought up wrong in being taught to spend so much time on our studies; we practised a false economy in being too thrifty in our earlier years." We were too late in learning that opportunity, sustaining power and a stimulus toward success come more from a wise good-fellowship than from high scholarship, and that the art of being what in your terse Western phrase is called "a good mixer" was an art well worth time, money and paternal advice to cultivate. It is by giving the technical graduate a wise start in this direction that he will ultimately come more often into the larger opportunity and higher salary of the commercial end.

This social feature is, in the final analysis, the chief value of the engineering societies. Altho papers are presented in which one engineer so presents his experience that a hundred others may find each his own course more clear in attacking a similar problem, and altho one may hear presented in an evening hour the results of experiments and research that have cost a year of toil, all so summed up in a few lines of formulas or constants that a repetition of this labor and expense is saved to all who follow, and altho the master mind may publish in the transactions a study upon difficult and disputed points that will lighten labor or save mistakes to many of his fellows; yet, after all, the pre-eminent usefulness of the Society of Engineers is in the bringing of men into personal relation, inspiring the young man by personal contact with the man who has done things, giving the older man a chance to size up the growing young men; and among equals it removes the bitterness to personally know our successful competitor and to know that he is a good, honest man.

*Extracted from the address of John R. Freeman at the inauguration of Charles Sumner Howe as President of the Case School of Applied Science.

The Flower Bed and the Flag.

It seems that our contributor, "W. Osborne," did not make himself known as such when visiting the shops of the Lodge & Shipley Machine Tool Company, and, referring to his account of his visit there (published at page 1716, Vol. 27), the editor has a letter from Mr. Shipley in which he says:

"We are very much complimented by the kindly remarks of your correspondent, and the fact that our advertisement this week is an illustration of our shops seems somewhat opportune—in fact, almost 'prearranged.' The only trouble about the flower garden, however, is that the gentleman did not come at the time of the year, evidently, that flowers grow in this neighborhood. We extend not only to yourself, but to him as well, a cordial invitation to come here about the middle of next June, and you will see not only a bed of flowers seventy-eight feet long, containing a thousand to twelve hundred plants, but the American Flag in all its glory—all as shown in our illustration."

Notes on Cranes.

BY A. D. WILLIAMS.

There are several types of trolleys used on cranes—double drum hoisting on both ends of the rope, single drum hoisting on both ends of the rope, single drum hoisting on one end of the rope, and double drum having two hoists. The drums may be at right angles with or parallel to the girders. Chain and wire rope are both employed for hoisting purposes, and where rope is mentioned in this article, chain may be substituted if desired. Rope, however, is more reliable, and if proper sheaves are used is very durable. It winds closely on the drum, which must be designed to suit it, and reduces the length of drum required for high hoists. Pocket wheel hoists are sometimes employed, but they are very rarely operated by power. Abroad some very heavy cranes have been built using flat-link built-up chains. A few screw hoists have been constructed, and a number of rigid-bar hoists, rack-and-pinion lift, are in use. The last are special machines designed to perform a single operation.

A trolley consists of a frame, one or more trains of gears, some shafting, one or more motors, and safety brakes. A solenoid or electric brake to hold the load when the current is cut off, and a safety clutch to prevent its running down too fast are provided. The motors may be electric, pneumatic, hydraulic or steam. Pneumatic and hydraulic cranes have a limited field. Steam cranes can be used wherever a track can be laid and coal obtained, and for many uses are almost indispensable. Electric cranes in mills, shops, yards and foundries have practically driven out all other forms.

For high-speed cranes cut gearing is usually employed, except for the drum gear and its mating pinion, which have cast teeth. Diametral pitches and involute teeth shapes are found convenient, as slight variations in the center distances due to wear and other causes are permissible. Circular pitch, however, is still in use, more particularly with cast gears, and special single-acting tooth shapes are used. Cast gears are either half shrouded or else run with a full shrouded pinion.

Some crane builders manufacture their own motors and have standards from which they decline to vary when business is good. Others use the standard Westinghouse or General Electric street-car type or other motor, and, while sticking as closely as possible to one make, will comply with the purchaser's specifications. The builder's interests are met by the motor that costs him the least in time, trouble and cash. He is thru with the crane when it has been accepted one year and paid for. The user, however, has it to keep, and it is generally very much quicker, easier and cheaper to get repairs to a standard make of motor than to one of a special type. Direct current of 110 to 500 volts is used, 220-volt current being a general favorite. Very few alternating current motors are in use for crane purposes, but there is no difficulty in the way of their use provided current is available.

The methods of designing shafting are well known. Bending and torsion must be taken care of. All the keyseats in each shaft should be of the same width and depth, and shafts should clear the hoisting chain. All bearings should be split, with removable caps and plenty of oil grooves. The bearings are generally lined with babbitt metal, but some who wish to be real swell insist on bronze bushings. Both kinds wear out, and it is slightly easier to refill a babbitted box than to make a bush for a slightly worn shaft.

The drums should be of sufficient length to take all the rope in a single wrap, an allowance being made for the fact that the rope will stretch slightly in use, and at least one full turn should remain on the drum when the hook is at its lowest point. Double drums taking up on the opposite ends of the rope are rarely required, unless the hight of hoist is very high, but are quite common on chain hoists. For slow-speed cranes, for power-houses and similar classes of service, single drums taking on one end of the rope, the other end being anchored to the trolley or lower block, are used. This type of trolley does not distribute the load equally to each track wheel. Both of the above twist the load slightly around its vertical axis in hoisting. Single drums winding from both ends toward the center, on both ends of the rope, are generally used; they give a vertical lift, the drums being at right angles to the girders, and the fall between them. For open-hearth ladle cranes two falls are required. The drums are mounted parallel with the girders and the falls outside of them. A small auxiliary trolley runs between the girders on their lower chord and is used for slagging the ladle and light lifts. Guide frames are often put on cranes for this work to steady the ladle and guard the squaring shaft. The load usually sways more on rope than it does on chain hoists.

Pocket wheel chain hoists are common on cheap hand cranes for light work, but are very rarely motor driven. A chain tank is desirable to prevent the slack mussing around loose, but is often omitted. The pocket wheel should have a chain guard to prevent snarls and keep the chain from jumping out of the wheel.

Screw hoists are rare. They may be of either the rising and falling nut or stationary nut type, driven by bevel gears or worm wheels. Two screws, a right-hand and a left-hand, the nuts being tied together to prevent their turning, avoid the use of the heavy guides and crosshead necessary with single screw hoists. A ball joint suspension is necessary to avoid bending stresses in the screws.

Rigid-bar hoists are commonly used for pit furnace cranes or vertical charging machines. The lift is usually by means of a rack and pinion and a slip device is necessary to prevent trouble from overrunning. The tongs are opened and closed by compressed air or a motor-driven trip device. A hand-wheel is used to swivel the tongs. The bridge travel is usually provided with a magnetic brake. The principal disadvantage of this machine is the amount of headroom required, 25 feet approximately over the runway rail. The bar is counterbalanced to save power. The operator of this machine travels on the trolley. Chain hoist ingot cranes have also been devised, the hoisting gear being mounted on a turntable on the trolley to swivel the tongs. The hoist is short and the chains are arranged with considerable pull off to prevent swaying.

Some special cranes have been devised for rolling the load on a horizontal axis, in addition to and coincident with the exercise of their other functions. These machines are used for handling heavy forgings under hammers, in which case an elastic suspension of the load is employed to avoid shocks to the machine. A crane of this type would be of use in a pipe galvanizing plant handling a large tonnage.

The trolley frame should be built up from the track wheels in preference to building up to them. This last construction is, however, employed for I-beam trolleys which necessarily must be of the suspended type. The frame connects and supports the mechanism and the top block. For light trolleys a single casting can be used, but for most work the structure must be built up, either from structural steel or from side castings and steel cross girders. Lightness is desirable in trolley construction, but there must be sufficient rigidity to the frame to keep the various bearings in line. The shafts should not be depended upon to act as tie rods or separators, as unless special provision is made for them to exercise this function, they fail to hold. The general shakiness and rapid deterioration in use of a great many cranes is due to this improper method of framing. Its cheapness in first cost is its only merit. It results in noisy gearing which rapidly grinds itself out, the bearings cut out and the repairs are frequent.

The wear on gear teeth is generally considered to be a good index as to their alinement. It is if the framing is rigid, but if it is limber the wear may be very evenly distributed by the working of the frame and the only safe test is to caliper between the ends of a tooth on the pinion and one on its mating gear close to their meshing point. This test should be made at several points around their circumference. Poor alinement is sometimes found in new cranes.

Sulfur, which is a nuisance and an impudent adulterant among the metals, still has a way of keeping itself uncontaminated. American producers of sulfur offer it 99.9 per cent. pure.

AMERICAN MACHINIST

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Some Editorial Problems.

We have, in a previous issue, likened the position of the editor of such a paper as this to the position of umpire of a baseball game. The umpire can never make decisions that will be just as every one of the players and every one of the spectators would like to have them. The umpire knows this perfectly well. He also knows that in all probability there are players in the game and spectators who know at least as much about its rules and regulations as he does and would be just as capable of rendering correct judgments on the close points of the game. But it is impossible for him to consult these men even if he could identify them and pick them out from the others who know less than he does and would not be so well calculated to render wise decisions.

But the responsibility for making decisions rests with the umpire. There may have been a mistake made when he was appointed to the position and he may himself think so, but having accepted the responsibility he, and he alone, must perform the duties of the position. He may listen to protests and give due consideration to the opinions of those who think differently from himself, but the final responsibility for decisions must rest with him alone, and he must therefore make them.

If an editor of such a journal as this possessed any natural tendency toward the affliction popularly known as "swelled head" he would with experience soon get over it. The mere going thru the correspondence would soon relieve him of any suspicion he might otherwise have that he was infallible, and he would soon abandon the idea that he could possibly publish any one number of the paper or even any one article that all his readers would approve of or that some of them would not severely condemn.

For instance, there was last year a series of articles relating to the process of development of a new turret lathe. We illustrated the lathe in a rather perfunctory way when it first appeared, but in talking with its inventor (who happens in this case to be at the head of the company which makes it and thus can do things some inventors and designers cannot do) he said that the experimenting that had been done in connection with the development of the machine had been very extensive; much of it had been very instructive to himself and to others connected with it. Some of the machines built during the trying-out process were running in his shop and all these machines, together with the drawings, photographs, data, etc.—failures as well as successes—were, he said, at our disposal for publication if we wanted them.

Now, we confess we were highly pleased to receive such an offer. Such an one does not come to an editor very often, and in fact, so far as we can recall, no other similar opportunity has ever been offered to the AMERICAN MACHINIST. We sent a competent man, familiar with machines of the class referred to and an expert with them. He found a wealth of what he considered the most valuable material, and his only regret was that there was a lot of it there, especially that which related to hydraulic feed experiments, which he simply could not handle within anything like a reasonable amount of space or at an expenditure of labor which at the time seemed possible to bestow upon it. So this part, tho it was freely placed at our disposal, was omitted. We, however, considered the articles we did publish exceedingly interesting and valuable.

During their publication we received a postal card, the writer of which did not sign his name, as follows:

"When the MACHINIST came out at first they hit other trade papers very hard in reference to mentioning special manufacture in their papers—now every once in a while we get a *dose* of Jones & L. Turret Machine. There is nothing so wonderful about their machines the motions are all mechanical we *buy* the paper to get instruction and knowledge and not *special* description of special firms—Keep up the squaring of number, and high-speed steel and time systems, &C and you will not *loose* subscribers."

About the same time we began to hear from the various men who look after advertising matters for tool-building concerns and who of course know nothing of technical matters connected with machine tool design or construction. They saw only one fact in connection with these articles, namely, that the firm building the turret lathe in question was getting a lot of advertising. They did not like this. Most of them thought probably that it was advertising pure and simple and never dreamed that the AMERICAN MACHINIST has readers who eagerly go thru all such records of experience and carefully study them. Some of them were ugly about it and hinted at fines they were going to impose upon the umpire.

About the same time we received a letter from the chief of the drafting room of a famous tool-building establishment, in which, after commending the articles, he says:

"The general plan of showing lines of experimenting thru failures or partial failures up to final success seems to me of value, and as far as a paper like yours can get hold of such information that manufacturers are willing to have published, it is in line of giving us valuable pointers as to what not to do as well as what will be successful."

He at the same time expressed regret at not finding in the articles full information regarding the use of fluid transmission of feed motions. In other words, he would have been better pleased had the articles been much longer, or more numerous.

A letter from the chief engineer and superintendent of another famous tool-building establishment expressed much the

same opinion and said that, not only he, but nearly all the men employed in the engineering and drafting departments had read the articles with great care.

And so it is readily seen that the umpire cannot make decisions that will suit all that take part in the game, nor all the spectators. He can only go on and do the best he can in each case, knowing that he will occasionally and perhaps often make mistakes, but hoping that, so long as he is honest and fair and does the best he can the players and the spectators will not, all at the same moment, be so outraged as to rise in their wrath and drive him off the field.

In the meantime if any other machine-building concern has equally interesting and valuable material which it is willing to place at our disposal we shall be glad to get hold of it and will go to any reasonable expense in publishing it. The firm supplying it will be more than welcome to any incidental advertising there may be in the publishing of it, and whether they appear in our advertising columns or not will make no difference.

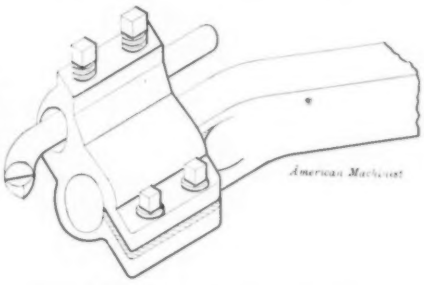
Our contributor, Mr. Edward F. Chandler, is taking part in the much discussed question of the quality of air found in the new subways in New York. His argument is a unique one, to the effect that the subways are simply large tubes, similar in their nature to those which are regularly used for the production of ozone by the action of electricity upon air; Mr. Chandler stating his belief that every flash or discharge of electricity which takes place between the contact brushes and the third rail or between the wheels and the rails develops a certain amount of ozone at a point in the tube which makes it especially likely to be fatal to microbes and that therefore the subway air is likely to be even better for consumptives and others than the ordinary air of the streets of the city.

Our contemporary, *Engineering News*, is, we think, perfectly justified in taking the I-told-you-so attitude as it does in its issue of January 5, with regard to fog in the new underground railroad. Seven years ago, when certain men and journals were advocating the construction of the subways, others were opposing them (for reasons probably satisfactory to themselves) and at that time *The Evening Post* dropped a remark indicating its belief that the subway would be free from fog. For this it was ridiculed by the *Sun* and the *Railroad Gazette*, and thereupon *Engineering News* took the matter up and gave reasons for believing that the subway actually would be free from fog. It now turns out that this is the case, for during a time recently when the city and vicinity were enveloped in a fog so dense as to make moving about by almost any other means extremely difficult and hazardous, the subway was entirely free from fog and its atmosphere was clear.

New Tools and Machine Shop Appliances.

ADJUSTABLE BORING TOOL HOLDER.

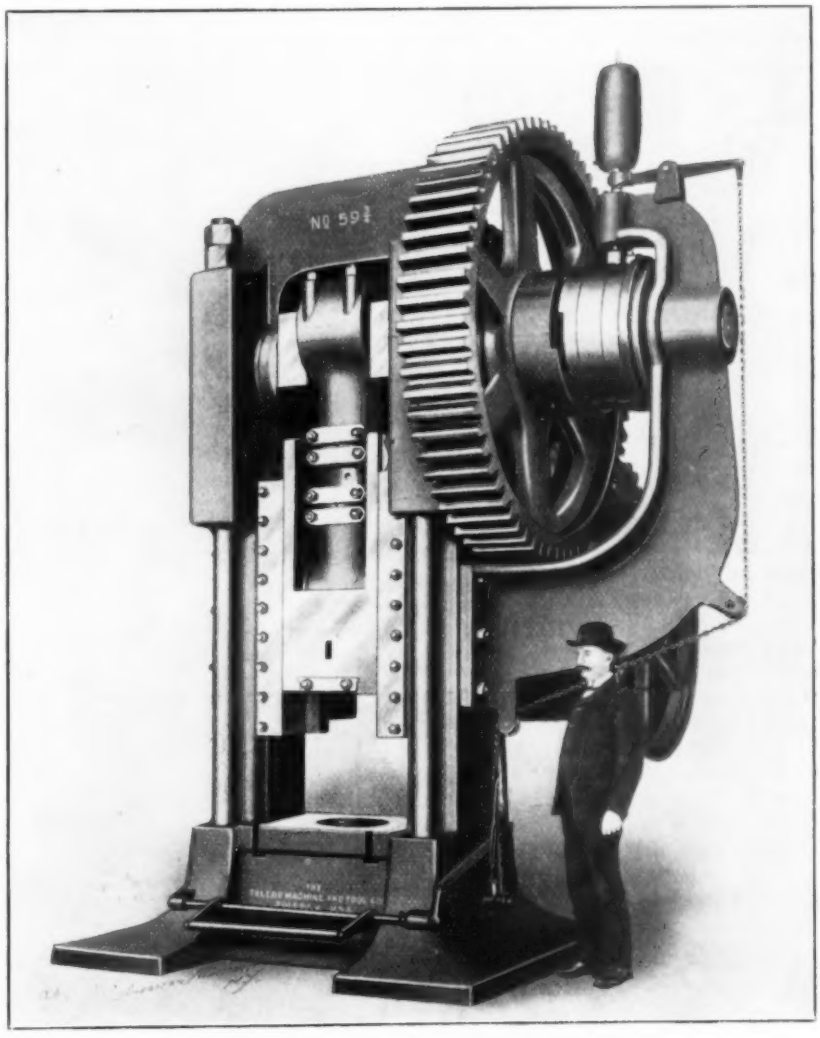
The illustration shows an adjustable boring tool holder which has been brought out by Joseph X. Mathieu and James F. Pullan, Great Barrington, Mass. In the larger sizes the holder is made as shown, but for bench and precision lathes in general the tool (made of drill rod) is clamped in a split receiver. The tool may be rotated in the holder to the desired position, and the end of the holder may be rotated on the shank so as to obtain the correct hight for the tool.



ADJUSTABLE BORING TOOL HOLDER.

A LARGE SINGLE-CRANK DRAWING PRESS.

The press shown in the halftone is believed to be the largest and most powerful single pitman, straight-sided press ever built in this country. It is designed for deep stamping, reducing metal ¼ inch and ⅜ inch in thickness for large wagon hubs, valve cases, etc. The single-piece casting of the frame weighs 40,000 pounds, being reinforced, as seen, by four 5-inch tie rods. The crank shaft is 13 inches in diameter at the bearings; the stroke of the press being 14 inches and the length of the slide bearings 55 inches. The shaft and the connection screw are high carbon, open hearth steel forgings. The connection screw has right- and left-hand threads for slide adjustment and is held in position by caps on the upper and lower connections clamped by four studs in each cap. The clutch is automatic, of the thru engagement sliding block type, controlled by a gravity-releasing attachment, the springs usually employed being dispensed with, this arrangement making the clutch one of the most positive and re-



LARGE SINGLE-CRANK DRAWING PRESS.

liable in use. The press is geared 1 to 15, the large gear, with teeth cut from the solid, ¾ diametral pitch and 14-inch face. The width between uprights is 38 inches, the press bed being 38x38 inches. The weight of the machine complete is 95,000 pounds. It was built by the Toledo Machine & Tool Company, Toledo, Ohio.

A NEW LATHE TOOL-HOLDER.

The accompanying illustrations show the Miller tool-holder for lathe use which is sold by the New Metal Tool Steel Company, of 100 Gold street, New York.

Fig. 1 shows a general view of the holder, which will be seen to take the place of the usual tool-post, being bolted to the tool-block as the tool-post usually is. The manner of holding the turning tool and the fact that it is well supported will be apparent from the illustration, as will the method of adjusting it for hight. The boring tool is clamped between two plates, reversal of the outer plate serving to adapt the holder to different sizes of tools. The absence of sockets surrounding the turning tool gives it an adaptability to working in

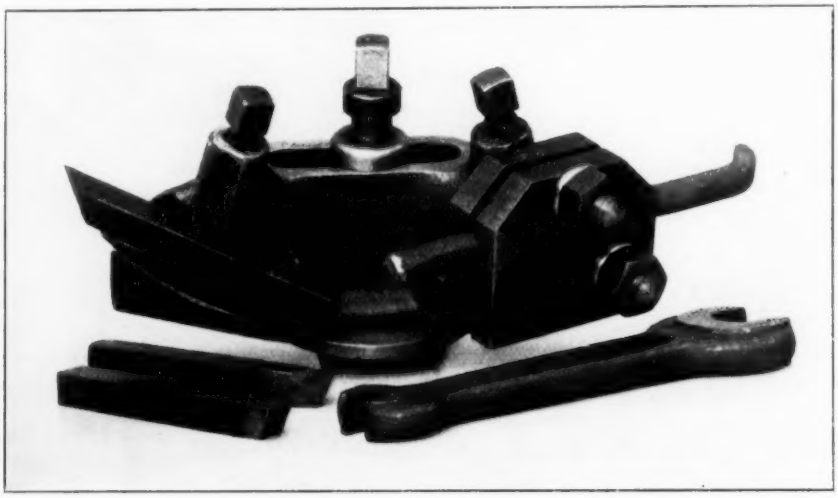


FIG. 1. THE MILLER TOOL-HOLDER.

corners which is shown in Fig. 2, the three central views of which show also a square nose tool used as a right-hand roughing, left-hand roughing and shoulder reducing tool. The fact that the tools are of square steel and hence capable of being placed in the holder any side up gives an additional flexibility which is partly shown in the right-hand view of Fig. 2. By simply turning in the holder the tool there shown as a right-hand side tool it becomes converted to a left-hand side tool.

BIG BORE TURRET LATHE.

The accompanying illustration shows a new Gisholt turret lathe of which the main outlines are very familiar to our readers. It has a 5-inch hole thru the spindle which thus adapts it to a large range of engine and railroad work, and it is also fitted with a three-jaw chuck for work on castings. It has a feed box giving eight feeds and is equipped with an oil pan and pump.

The Modern Economies in the Railroad Shop.

We take the following from an address by Robert Quayle, superintendent of motive power, Chicago & Northwestern Railway, to engineering students of Iowa State College:

Touching upon the question of shop practise, it has often been said that if railroad shops were run with the same business sagacity that contract shops are run, the superintendents of motive power would enable the railroad company to pay greater dividends. This, in a large measure, is correct, so far as it pertains to the by-gones, but during the last few years wonderful strides have been made by the motive power departments in the direction of introducing modern tools and facilities to cut down the cost. The introduction of high-speed steel in the railroad shops

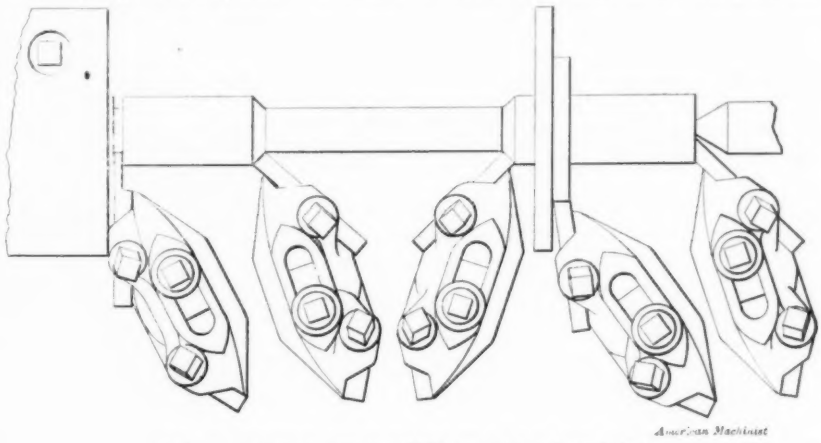
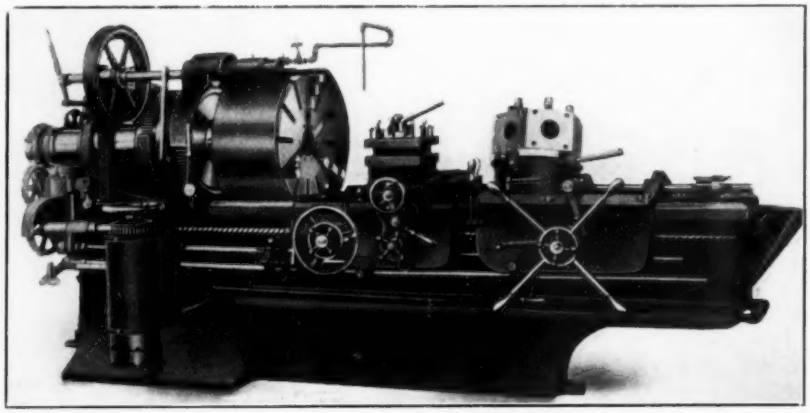


FIG. 2. VARIOUS APPLICATIONS OF THE TOOL-HOLDER.

has made marvelous changes, and has obtained splendid results. The introduction of this, however, has found many weak tools or machines which have had to be set aside and new and more powerful machinery installed, in order to be able to do the work that the high-speed steel is capable of doing.

The railroad mechanical engineering offices of to-day have standardized the parts of locomotives so that we are enabled to use jigs, and everything that can possibly be interchanged is designed with that end in view, and parts of smaller engines that can be used standard for parts of larger engines are used wherever it is possible. Much thought is given in this direction, and a decreased cost for operating this end of the department is the result.

In most contract shops they have only to deal with new work and they build a certain kind of machine, pump, engine or other device; their work is nearly all duplicate work, and they get their product out in large numbers, which, of course, enables them to do the work more cheap-



THE BIG BORE TURRET LATHE.

ly than can be done in a locomotive shop, where it is nearly all repairs and where each repair job presents different conditions. But let me say that in the railroad shops with which I am acquainted to-day, every department is striving energetically, systematically and intelligently to cut out all unnecessary labor and cost.

Alcohol Motors in France.

Robert P. Skinner, United States Consul General at Marseille, contributes to *Consular Reports* the following interesting information concerning the present status and prospects of the alcohol motor in France:

In spite of official encouragement, it may be said that alcohol motors and carburetors remain to-day incompletely developed. Many manufacturers have their particular forms of carburetors, but I am informed that one device is in greatest demand; yet even of this type, out of 60,000 carburetors sold only 500 were intended for the consumption of pure alcohol, all the others being destined for the use of gasoline or of carbureted alcohol. The sale of alcohol motors has been equally unimportant. Probably 100 petroleum or gas motors are sold to one alcohol motor, for three reasons: (1) The high cost of the alcohol; (2) the greater consumption per horse-power hour than of either petroleum or gas; (3) the difficulties arising from oxidation.

The principle upon which the alcohol carburetor referred to operates is the same as of the carburetor for gasoline. These carburetors are manufactured for motors of from 4 horse-power upward; they differ from the form intended for use with gasoline, etc., in that the reheating system is more intense. They operate as regularly as the other carburetors. In their application to motors their advantages and disadvantages are thus described to me: Additional suppleness in movement, but increased consumption as compared with gasoline; initial heating of carburetor necessary; possible oxidation of plugs, pistons and piston rings unless care be taken to run the motor with gasoline during the last moments of use.

The motors operating with alcohol comprise two categories—stationary motors and motors of automobiles. Those of the first class are generally gas motors transformed by the simple addition of a carburetor and by some modification of detail. The automobile motors are the same as those designed for the consumption of gasoline with another form of carburetor.

A method of using alcohol has lately been tried, consisting of forcing the alcohol at a desired temperature thru a vaporizer in a quantity strictly measured to meet the machine's need at the moment. At the last public competitions for a 6 horse-power motor the consumption was 410 grams per horse-power hour, as against 578 grams with the carburetor above referred to.

American Production of Steel Hardening Metals.

BY A. F. TENNILLE.

A recent report on the production of steel-hardening metals in the United States is of a great deal of interest. Under this head are included nickel and cobalt, chromium, tungsten, molybdenum, vanadium, titanium and uranium, named in the order of their importance for steel-hardening purposes. Manganese should naturally be included, but on account of its very extensive production and its large use in the purification of steel it has been thought better to treat of it in a separate report. A peculiarity of the metals named above is that they are not added to the steel in the process of manufacture to cause chemical reactions which drive off harmful ingredients, as are ferrosilicon and ferromanganese. They are added only after the steel has been manufactured, and the benefits conferred on the steel are of a physical nature.

The special steels resulting from these additions vary among themselves, having individual properties of tensile strength and elastic limit, of conductivity of heat and electricity, of magnetic capacity and of resistance to impact, whether as shell or armor plate. It is only about twenty years since the first of these metals, nickel, began to be used to any extent for the hardening of steel. Experiments to determine the quality imparted by these various metals, and their consequent commercial value, are now conducted on a large scale by means of the electric furnace, which makes possible the reduction of the ferro alloys directly from the ores.

Most of the nickel and cobalt produced in the United States comes from the Mine La Motte, Missouri, where it is obtained as a by-product in lead smelting. The production amounted in 1903 to 661 tons of matte. The nickel content of this matte was 114,200 pounds, valued at $45,900, and the cobalt oxide content was 120,000 pounds, valued at $228,000. The production of nickel and cobalt ores in the United States during 1903 amounted to 135 tons, obtained in Oregon and Idaho during the processes of development work. Only 21 tons, valued at $1,900 were shipped. As nearly all the nickel used in the United States is obtained in Canada, tables have been included in the report showing the amount of the year's output.

California is the only State that produced any chromite, as the ore of chromium is called, during the year 1903. Its output amounted to 150 long tons, valued at $2,250. At the present time nearly all the chromite used in the United States is imported from Asiatic Turkey, New Caledonia and Canada.

The production of crude tungsten ores in the United States during 1903 was 2,451 tons. Most of this ore was concentrated. The prices for it varied from $110 to $250 a ton, according to the percentage of tungstic acid it contained. Many new localities were discovered in 1903 where these ores are found in greater or less quantities. The principal mining was done in Colorado and in the vicinity of Dragoon, Ariz.

A number of new localities were discovered in 1903 where molybdenum ores occur in quantity. The production of molybdenite ore during 1903 amounted to about 6,200 tons of crude ore, very little of which was treated. Most of the wolfenite ore which was mined was concentrated, and these concentrates, together with those of the molybdenite, amounted to about 795 short tons, valued at $60,865.

Considerable development work was done during 1903 upon uranium and vanadium deposits. The result was a product of 432 short tons of crude ore. Of this amount 30 tons of partially concentrated ore, valued at $5,625, were sold. Nearly all the uranium and vanadium ores mined in the United States are exported. On the other hand, a considerable quantity of both of these salts is imported each year. The value of these importations for the year 1903 was placed at $13,498.

Technical Publications.

"The Indian Textile Journal Diary and Reference Book" for 1904. 164 3¼x5½-inch pages. The Indian Textile Journal, Bombay. Price one rupee.

The custom of many of our English contemporaries of publishing a pocket book which is revised annually has been carried to far-away India. The contents of the volume under notice are, of course, chiefly interesting to those engaged in cotton manufacturing. Lists of Indian and Japanese cotton spinning and weaving mills are given, from which we learn that the former country contains 194 and the latter fifty such mills. The remainder of the book is of a technical character, comparable in its general nature with that found in engineers' pocket books.

"A Course of Instruction in Elementary Machine Design." By J. D. Hoffman. Part I, 23 8½x11-inch pages with 31 illustrations; Part II, 36 8½x11-inch pages with 67 illustrations. Burt-Terry-Wilson Company, Lafayette, Ind.

These pamphlets form, so far as it has been put in type, the course in machine design given to the mechanical engineering students of Purdue University. Part I takes up the subjects of tension, compression, flexure and shear, and then applies them to a simple toggle joint press, the forces being analyzed and the parts then designed to suit them. Part II adds the consideration of torsion and then takes up the design of a belt-driven punch press, the forces being analyzed and the parts de-

signed as in Part I. Part III, to follow, will take up cylinders, pistons, valves, etc., in a similar manner. The subject matter is in the form of notes rather than that of a treatise, as familiarity with theoretical mechanics is assumed. The discussion will be seen to be strictly concrete and to lead to the design of complete machines, rather than of detached parts. For college use it forms one of the most satisfactory methods of presenting the subject that we have seen.

"The A B C of the Differential Calculus." By W. D. Wansbrough. 148 5x7¼-inch pages, with 30 illustrations. The Technical Publishing Company, Manchester. Price 3 shillings.

This book is a praiseworthy attempt to smooth the path of the beginner in the study of the calculus by explaining first of all its fundamental philosophy. In doing this it adopts a combination of the infinitesimal idea and of the limit idea. Thus it regards $\frac{dy}{dx}$ as a limiting value and at the same time it regards dy and dx as both zero and not quite zero—that is, as having values less than any assignable value. Having values they are not zero, but those values being less than any assignable value they may be treated as tho they were. While the discussion is probably as clear as any which clings to the infinitesimal idea can be, we cannot regard the result as satisfactory. The regarding of a thing as both something and nothing, or the conception of two kinds of zeros, cannot be defended and is not in fact at all necessary in the study of the calculus. The author should read Bledsoe's "Philosophy of Mathematics" to learn how fatally defective, philosophically speaking, is the infinitesimal idea and he should then read Byerly's "Differential Calculus," in which the subject is developed purely on the limit idea and without so much as a mention of infinitesimals, which uses a notation that gives the student no inkling that anyone ever had such a conception of the subject, which explains no philosophical difficulties because it has none to explain and which introduces the differential notation only after the student's conceptions of the subject are formed and as a practical expedient in connection with integration.

The Western Society of Engineers, J. H. Warder, secretary, 1734 Monadnock Block, Chicago, Ill., has elected the following officers for the current year: President, Edward C. Carter; first vice-president, G. A. M. Liljencrantz; second vice-president, Chas. F. Loweth; third vice-president, L. P. Breckenridge; treasurer, Andrews Allen; trustees, B. E. Grant, T. W. Snow, Geo. M. Wisner; past presidents in the board of direction, W. H. Finley, Ralph Modjeski, H. W. Parkhurst.

In the United States 527,467 horse-power of water power is applied to electrical service.

Incorporation of the Cleveland Twist Drill Company.

The history of this company is an interesting one, and in many respects typical of the growth of American industrial enterprises. In 1874 J. D. Cox in a very modest way began manufacturing tools in Cleveland. Five years later F. F. Prentiss joined him and for twenty-five years the partnership was known as the Cleveland Twist Drill Company. The business prospered, until to-day its product is found wherever civilization exists. The immense factory, built up as increased business demanded, and equipped with special and modern machinery and appliances, further attests the result of successful business methods. After thirty years of constant activity Mr. Cox has decided that he has earned a little rest and relief from responsibility, this decision being hastened by the fact that his health demanded a change. The partnership was therefore merged into a stock company, December 31, 1904, without change of firm name. Before transferring the partnership affairs to the stock company several of the old employees were invited to take stock and the opportunity was readily accepted by all to whom the privilege was accorded. While Mr. Cox will be relieved of active duties, he will still retain his large holdings and also serve in the capacity of vice-president and director.

The other officers of the company are: F. F. Prentiss, president and general manager; E. G. Buckwell, secretary; Geo. F. Kast, treasurer.

Notwithstanding the change the personnel of the company remains intact and the guiding spirit of the past will continue to direct the future.

Personal.

Russell Robb has become a partner in the firm of Stone & Webster, electrical engineers, Boston, Mass.

E. S. Lea has resigned his position as sales manager for the De Laval Steam Turbine Company and has opened an office at 42 Broadway, New York, as consulting engineer. He will make a specialty of turbine engine power plants and pumps.

W. L. Campbell, who has been in charge of our Information Department, has been appointed to represent the AMERICAN MACHINIST, *Power* and the *Engineering and Mining Journal* in Central and Eastern Canada, with headquarters for the present at 114 Catharine St., N., Hamilton, Ontario.

W. S. Montgomery, who was for many years sales manager for the Conover Condenser Company, and for the past year New York manager for the Payne Engine Company, has formed a partnership with G. M. Rogers under the firm name of Rogers & Montgomery, with offices at 147 West Twenty-third street, New York city. The new firm will deal in a general line of small labor-saving tools, and are the exclusive United States sales agents for the new line of patented hand and press punches made by the Gem Tool Works, of Brooklyn.

Obituary.

Edward A. Walcott, of the tool-building firm of George D. Walcott & Son, Jackson, Mich., died December 28.

John Briggs, treasurer of Peter A. Frasse & Co., New York, dealers in tools and hardware, died January 5. He had been identified with the hardware trade thirty-three years.

Edward D. Jones, president of the E. D. Jones & Sons Company, Pittsfield, Mass., builders of paper mill machinery, died December 30, eighty years old. He had been building beating "engines" more than fifty years.

Hamilton E. Smith, an inventor and a pioneer in building steam laundry machinery, died recently at Salina, Kan., where he had gone for his health. He was born in Kentucky in 1819. He was for many years in partnership with Benjamin A. Dare in New York, and later was in business in Philadelphia.

Robert K. Barr died in Philadelphia, January 3, sixty-two years old. He was born in Philadelphia and served his time there as a machinist. Later he went to Montgomery, Ala., and engaged in business. When the war broke out he tried to come North, but was impressed by the Confederates and compelled to serve as an engineer. In later years he held responsible positions at Cramps' shipyard and with Neafie & Levy.

Business Items.

On and after January 1, 1905, The Hendey Machine Company, Torrington, Conn., will be represented in New York, Philadelphia and Pittsburg by Manning, Maxwell & Moore. The Hendey Company has discontinued its agencies with Hill, Clark & Co., Boston, and Thomas & Lowe Machinery Company, Providence, and will handle the New England territory direct.

The rigid specifications drawn by the United States Navy Department for auxiliary engines required in the equipment of vessels of recent construction have done much to improve their general standard of efficiency. It is therefore unusual to find that these requirements have been improved upon. Such, however, is true in the case of recent designs of vertical cross-compound engines built by the B. F. Sturtevant Company, Hyde Park, Mass., for direct-connected generator driving. They have actually shown, upon an economy test, a consumption of steam per horse-power per hour fully 4 pounds less than that demanded by the specifications. These results are characteristic of a line of specially high grade engines being built by the above mentioned company to develop from 25 to 150 horse-power.

The California Gas & Electric Corporation, of San Francisco, has ordered from the Stanley Electric Manufacturing Company two frequency changing outfits of 5,000 kilowatts capacity each, amounting to virtually 20,000 kilowatts capacity divided between four machines operated as two motor generator sets. These outfits are for use in connection with the contract which the California Gas & Electric Corporation has secured from the

San Francisco Street Railway Company, and will change the 60-cycle current from the Bay County long-distance line to 25 cycles for further distribution among the substations of the Street Railway Company. The contract awarded the Stanley Company also includes transformers of 12,000 kilowatts.

The National Electric Company, Milwaukee, Wis., has been awarded a contract for air brakes for the cars of the Cleveland Electric Railway Company.

Manufacturers.

The Tennant Auto Tire Company, Springfield, O., may move to Dayton.

The Monroe (Wis.) Gas Company will probably enlarge and extend its plant.

The Utah Sugar Company, Salt Lake City, may establish another factory shortly.

A cotton factory company is being promoted at Selma, N. C., by M. C. Winston.

The Lydia Cotton Mills, Clinton, S. C., will this year add 8,000 spindles and 200 looms.

The Bonham (Tex.) Cotton Mills Company has appropriated $75,000 for new machinery.

The ice tool factory of Wm. T. Wood & Co., Arlington, Mass., has been damaged by fire.

Chas. E. Perry & Co., will make improvements at their paper factory at Hyde Park, Mass.

The Adrian (Mich.) Metal Post Company is considering the advisability of erecting a factory.

The Ferguson Buggy Company, Ann Arbor, Mich., is thinking of building a plant in Toledo, O.

The Sheet Metal Recovery Company is starting to build a new plant at or near Waverly, N. J.

The Cleveland Twist Drill Company has filed articles of incorporation, with a capital stock of $1,000,000.

The plant at Petersburg, Va., of the Southside Manufacturing Company, baskets, crates, etc., will be rebuilt.

The Wolverine Motor Works, Grand Rapids, Mich., gasoline engines, etc., proposes to locate at Suffern, N. Y.

The plush manufacturing firm of Deuger & Steiner, Rahway, N. J., is thinking of building a sixty-loom plant.

The Heffernan Engine Works, Seattle, Wash., has in hand the construction of a plant costing $250,000.

August Andreas, of Easton, Pa., has been in Petersburg, Va., relative to the proposed establishment of a silk mill.

The tin plate mill at Chester, West Virginia, owned by the American Tin Plate Company, will shortly be enlarged.

R. A. Mack and Hollis C. Johnston, Gallipolis, O., are organizing a company for the manufacture of extension tables.

An addition, besides boiler- and engine-house, is about to be built to the Orinoka (Textile) Mills, Philadelphia, Pa.

The South Muscatine Lumber Company, of Muscatine, Ia., is said to be negotiating for a mill site in Northern Wisconsin.

The Commercial Club, Paris, Ill., has conveyed to John J. Cummings, of Chicago, a site for an interurban car factory.

The Board of Trade, Cuyahoga Falls, O., has received an inquiry for a chair factory site from F. D. Brown, of Cleveland.

Forty coke ovens will be added to the plant of the Milwaukee (Wis.) Coke & Gas Company in the Kinnickinnic valley.

The plant of the Sharp Manufacturing Company, pumps, windmills, etc., Albert Lea, Minn., has been somewhat damaged by fire.

The Standard Ventilator Company, of Milwaukee (capital, $25,000) may build a manufacturing plant to employ about twenty men.

A building of the Goshen (Ind.) Manufacturing Company, ladders, hay slings, etc., in course of construction, has been blown down.

Swift & Co., packers, Chicago, Ill., propose to remove their soap factory to Kansas City, together with their cannery and tin can factory.

The plant of the Lehigh & Northampton Gas & Electric Light Company at Catasauqua., Pa., will be reconstructed and modernized.

A $200,000 electric plant is to be built by the West Side Electric Company, Manitowoc, Wis., of which ex-Mayor Wm. Rahr is president.

A canning factory is proposed for Shelbyville, Tenn. Among those interested are J. H. Neil, Jr., and Judge McCorkle, of the County Court.

R. J. Stough, J. B. Cornelius and others propose to organize a stock company with $30,000 to establish a knitting mill at Cornelius, N. C.

It is understood that the Whitaker-Glessner Company, Wheeling, W. Va., will build a new mill, probably at its Laughlin plant in Martin's Ferry, O.

The Paraffine Paint Company, of Emeryville, Oakland, Cal., contemplates the addition of a $100,000 plant for the manufacture of paraffine paper.

The Simplified Account File Company, of Zanesville, O., has written to the Chamber of Commerce, Colorado Springs, Colo., in regard to building a plant in that city.

The Bullock Electric Manufacturing Company has closed contracts for the erection of a four-story building, 55x210 feet, on the west side of Forest avenue, Norwood, O.

The American Seeding Machine Company, with general offices in Springfield, O., is said to be considering plans looking to the enlargement of its plant at Richmond, Ind.

The Alleyne Brass Foundry Company, Cleveland, O., maker of automobile castings, etc., has bought a site at Detroit, Mich., for a branch factory to employ about 100 men.

The Morse Chain Company, Trumansburg, N. Y., contemplates building a plant in Ithaca to cost about $60,000 and employ 150 men. The removal may not take place for a year.

Nelson Delaney address not given, with parties at Marion, Ill., has a project for starting a cultivator factory in the Nesbitt veterinary hospital building, which he has purchased.

Property at St. Louis, Mo., has been sold to Fred Herkert, of the Herkert & Meisel Trunk Company, of that city. He will improve it with a five-story building for manufacturing purposes.

A 38x84-foot manufacturing building is about to be built for Theo. Alteneder & Sons manufacturers of drawing instruments, Philadelphia. It will be four stories high, equipped with a power plant.

The plant of the Oklahoma City (Okla.) Packing Company is expected to be improved by building a lard refinery, adding to the cold storage facilities, installing a fertilizer plant and glue department, etc.

The Fox River Valley Marble, Granite & Cut Stone Company, composed of Paul Schroeder, Appleton, Wis., and others, is about to build a factory there, 150 feet long, to be equipped with machinery.

Weston & Graham, of Republic, Wash., will remove their factory for razors and other edged tools to Walla Walla in the near future, enlarging it. They have just patented a process for tempering steel.

The Standard Sanitary Manufacturing Company is said to have decided to enlarge its plant at Louisville, Ky. The improvements will include a 300x120-foot foundry and a new power plant, and 200 more men will be employed.

Chas. P. Mercer, of Portland, Ore., lately visited Worcester, Mass., with a view to the purchase of between $30,000 and $40,000 worth of machinery for a machine shop in Portland, and a shop in another Oregon city, not yet decided on.

The Dana Manufacturing Company, maker of Peerless ice-cream freezers, Cincinnati, O., has purchased about five acres at Norwood on which it intends to erect factory buildings for machine shop, foundry and woodworking purposes, etc.

Owensboro, Ky., is to have a new wagon factory. The Hickman-Egbert Company, with a capital stock of $100,000, has filed articles of incorporation. J. H. Hickman, formerly president of the Owensboro Wagon Company, will be president.

The Henlopen Manufacturing Company has been organized at Georgetown, Del., to operate a new tin box factory. Former Governor Ebe W. Tunnell is one of the stockholders, and the others are Dr. U. W. Hocker, William Hocker and William H. Vidden.

Sears, Roebuck & Co., merchandise house, Chicago, Ill., have let the contract for building a model town. The contract is reported to amount to about $3,000,000, and covers the erection of eight buildings having a floor area of about 2,000,000 square feet.

The Massachusetts Oilless Bearing Company has been organized in Boston under the laws of Massachusetts and projects the establishment of factories in Boston and Worcester, Mass., and Manchester, N. H. Ira B. Forbes is secretary; capital stock, $400,000.

The Southern Skein & Foundry Company, Chattanooga, Tenn., has completed organization, purchased 16 acres of land and will erect large buildings for foundry, forge, machine shop and patternmaking purposes, etc. G. N. Prentiss, now at Chattanooga, is secretary.

W. W. Stall, president and manager of the factory exchange, Watertown, Mass., reports that he has leased a factory and water power to Messrs. Burnett and Mason, who will occupy for the purpose of manufacturing a patented hose nozzle and other brass specialties.

It is stated at Billings, Mont., that Col. H. W. Rowley and Senator Christian Yegan have returned from Chicago, where they went, in company with P. B. Moss, to organize a company to erect a beet sugar plant in Billings. The matter seems to be progressing satisfactorily.

From Duluth, Minn., comes the report that the Great Northern Power Company has let the general contract for its development of the power of the St. Louis River to the National Railway Construction Company, Boston, Mass. C. A. Duncan is president of the power company, and C. C. Cokefair, general manager.

An air-brake company from Chicago, Ill., has purchased half a block at Fourth and Wewatta streets, Denver, Colo., and will open a plant for the manufacture of brakes and other machinery in about six months. It is expected 300 men will be employed. The company purchased the ground thru Wilkins & Cornish.

It is stated at Hackettstown, N. J., that the industrial committee of the Board of Trade had sold the Salmon lumber yard in Hope street to Frederick B. Warren, who is associated with Bradford Lee Gilbert, an architect. A company will be organized for the manufacture of interior trim, sash, blinds, doors and hard woodwork.

Having discovered that chair seats can be made cheaper by machinery than by the prisoners, a certain chair company has discontinued sending work to the jail of Litchfield County, Conn. The county commissioners have taken the matter in hand and contemplate installing machinery for chair seating, to be operated by the prisoners, and appointing agents to collect the chairs to be mended or reseated.

Denver, Colo., and Quincy, Ill., capitalists have formed the Nevada Power Company to supply power to mines and mills at Goldfield. It is capitalized at $1,000,000. Power will be furnished by hydro-electric transmission and will be generated by the waterfall of Bishop Creek, on the eastern slope of the Sierras, eighty miles from Goldfield. Rodney Curtis, F. J. Campbell, C. M. Hobbs and G. S. Wood, of Denver, and Col. Edward Prince, of Quincy, are backing the project.

New Catalogs.

Raymond Manufacturing Company, Corry, Pa. Illustrated catalog of springs and wire specialties. 5x6¾. pp. 20, paper.

F. W. Ridlon & Co., Springfield, Mass. Circulars showing the "R. & R." test indicator and hight gage and the Ridlon tool box.

Prindle Pump & Engineering Company, 95 Liberty street, New York. Illustrated catalog of Prindle standard house tank pumps. 6x9, pp. 16, paper.

Keystone Blue Paper Co., Philadelphia, Pa. Pamphlet describing in full and illustrating the electric blueprint machine made by this company. 6x9, pp. 8, paper.

Canadian General Electric Company, Toronto, Ont. Section No. 1 of supply catalog, including annunciators, bells and house supplies. Illustrated. 8x10½, pp. 56, paper.

De La Vergne Machine Company, foot of East 138th street, New York. Neatly illustrated folder showing some types and applications of the Hornsby-Akroyd oil engine.

The Frasse Company, 38 Cortlandt street, New York, is sending out a special descriptive price list of machinists' cheap small tools and supplies. Illustrated. 3¾x8½, paper.

Browning Engineering Company, Cleveland, Ohio. Bulletin No. 4; locomotive cranes, Nos. 2 and 3 standard, with accessories, described and shown in detail. 6x9, pp. 29, paper.

Warren Webster & Co., Camden, N. J. "The Cardinal Points of the Webster Feed-Water Heater and Chemical Purifier" is the title of an attractive booklet issued by this company. 3¼x6, pp. 15, paper.

Northern Engineering Works, Detroit, Mich. Miniature catalog showing in condensed form a few of the many types of cranes made by this company. Half-tone illustrations. 3½x5½, pp. 28, paper.

American Electric & Controller Company, 12 Dey street, New York. Bulletin No. 1, showing the "Rheocrat," a new controller for variable speed motors. A full description of this controller is given at page 1687.

The Electric Storage Battery Company, Philadelphia, Pa. This company has issued a neat little booklet, with celluloid cover, describing "Chloride Accumulators" and containing a number of pages of useful tables and data.

Newhall Chain Forge & Iron Company, 9 Murray street, New York. "Forgings and Castings," giving illustrations and lists of sizes of "Warwick" chains for various uses, hooks, shackles, rafting dogs, barge anchor davits, chocks and cleats, etc. 6x9, pp. 32, paper.

Crocker-Wheeler Company, Ampere, N. J. Catalog of railway generators, built by this company, of the Intramural Railway Power Plant at the St. Louis Exposition. Illustrated. These generators are now offered for sale, with delivery after January 1. 5x7½, pp. 16, paper.

Friedrich Schmaltz, Offenbach on Main, Germany. Grinding machinery, including twist drill grinders, cutter grinders, cutter sharpening and grooving machines, milling head grinders, universal grinders, vertical automatic grinders and many other machines for standard and special work. Illustrated. 6x9, pp. 48, paper.

Alberger Condenser Company, 95 Liberty street, New York. Alberger barometric condensers, central condensers, dry vacuum pumps, Corliss horizontal, vertical and two-stage; centrifugal circulating pumps and series-multiple centrifugal pumps; cooling towers, exhaust relief valves and exhaust strainers, surface condensers. Full descriptions and illustrations. 6x9, pp. 47, paper.

The Westinghouse Machine Company, New York. "A Few Words About Mechanical Stokers." This attractive and valuable catalog is divided into two sections. The first part deals with the design and construction of the Roney mechanical stoker, giving sectional and other views and full description. The second section is devoted to reproduced photographs of power plants in which Roney stokers have been installed. These include many of the largest power stations in America. 7x9, pp. 62, paper.

United Engineering & Foundry Company, Pittsburg, Pa. "Rolling Mill Machinery." This very comprehensive and well gotten up catalog covers a wide line of rolling mills, vertical shears and punches, rail straighteners; guillotine, tin plate squaring and tin plate doubling and hydraulic shears; hot and cold metal saws, roll turning lathes, hydraulic accumulators, hydraulic cranes, grinding mills, etc., together with a large line of tube works machinery. Well illustrated throughout by half-tones and reproduced photographs of installations. 8x10, pp. 205, cloth.

Alfred Herbert, Ltd., Coventry, England. "Modern Turret Lathe Practise" is the title of a publication recently issued by this firm, which treats of repetition work with Herbert machines. Brief descriptions and illustrations of samples of work are given of semi-automatic lathes for bar work, turret lathes for chuck work, semi-automatic capstan lathes for chuck work, capstan lathes for small work, automatic machines for bar work, automatic machines for chuck work, and auxiliary machines and apparatus. The book is offered to all interested in turret lathes. 7x9¾, pp. 84, paper.

The Deane Steam Pump Company, Holyoke, Mass. Condensers. Catalog No. 1023, in which are reviewed the principles and advantages of the several types of condensers as applied to steam engines, including surface and jet condensers. Vacuum pumps, exhausters, air and circulating pumps and other auxiliaries are also discussed. A recent development, which is treated quite fully, is the provision of proper condensing arrangements for steam turbines, vertical and horizontal. The book will be found of value to all having to do with steam power plants. Illustrated. 5¼x7¾, pp. 104, paper.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Addressing machines for office use. Joline & Co., 123 Liberty St., New York.

Designer of tool and automatic machinery. Fred Mill, East View, Cincinnati, O.

Mark your tools; a 3-initial stamp, 50 cts., post paid. J. L. Lucas, Bridgeport, Conn.

Light mach'y to order; model work; rubber molds. J. W. Weir, Bridgeport, Conn.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Drafting, machine, engine or power plant designing; low rates. Box 16, Youngstown, O.

Automatic machinery designed and constructed by the Weliman Sole Cutting Machine Co., Medford, Mass.

Auto. machinery of all kinds designed and built; hardened and ground work, flat or circular. Wiebking, Hardinge & Co., Chicago.

The Canada Machinery Company, Limited, Sarnia, Canada, have the facilities and are open to manufacture, for patentees and others, machines and machinery for the Canadian market.

Wanted—To furnish competent men for positions as managers and heads of departments in the metal-working or machine business, and the past experience of each, for which there is no charge; also want competent men to register for such positions. Address James Brady, 168 Lefferts Place, Brooklyn, N. Y.

Business Opportunities.

Would like to combine with capital to patent and build here, in Ohio, several good, new articles (tool line); in actual use as a test. "Experienced Machinist," care AM. M.

Third interest for $10,000 in old, high-grade manufacturing company; has always paid dividends besides accumulating surplus of $44,500; inside salaried position; ill health. Box 168, AMERICAN MACHINIST.

Successful and thorough salesman, commercial and office man, young, energetic and well known in machine trade, seeks position, partnership or interest in some machine, supply or tool business, where his talents will count; can invest up to $25,000. Address Box 172, AMERICAN MACHINIST.

For Sale.

For Sale—A going machine shop; large future possibilities; cause of sale death in firm. W. D. Judson, New Haven, Conn.

For Sale—At a bargain, an entire 50 H.-P. steam plant, in excellent order; write at once. Symons & Packer, Adena, Ohio.

I can sell your machine shop (or other business), with or without real estate, no matter where it is or what it is worth. Send description, state price and learn how. W. M. Ostrander, 111 North American Bldg., Philadelphia.

For Sale—United States patent No. 719,854, 1903, for best water gage in the world; now giving splendid results on English market; see description on page 788, December issue of POWER. Apply James Robinson, G. P. O. Leeds, England.

For Sale—A controlling interest in a small manufacturing and jobbing machine shop in growing city in southern Michigan; well-established business; a splendid chance for a young machinist ambitious to have a shop and business of his own. Address A. B. C., care AMERICAN MACHINIST.

New modern brick machine shop, centrally located in Philadelphia, size 40x100 ft., with clear story, lantern, gallery and traveling crane, fully equipped with new machine tools, having sold former business, is offered for sale or rent, or will combine with going concern requiring these facilities and some additional capital. Box 140, AMER. MACHINIST.

For Sale—Four Watts-Campbell Corliss engines, 24x56; 400 horse-power at 100 lbs. steam pressure; 70 revolutions per minute; flywheel—diameter 20 ft., face 46 in.; condition first class. One double Watts-Campbell Corliss engine, 18x42; 250 horse-power at same pressure; 91 revolutions per minute; flywheel—diameter 16 ft., face 32 in. One N. Y. Safety engine, 12x12; 75 horse-power at same pressure; 250 revolutions per minute, 2 belt wheels, 4½ ft.; diameter 17½ in. and 13 in. face. Will sell singly. Can be seen in New York city by addressing The United Electric Light & Power Company, 1170 Broadway, New York city.

Modern machine shop building for sale, cheap, on easy terms, or lease. This factory property is located on the Central Railroad of New Jersey, at Greenville Station, Jersey City, 16 minutes from Liberty St. Ferry, New York. The ground is 100 ft. by 200 ft., and has a railroad siding into the building. The building is modern brick and structural steel, with 80 ft. cross-section, 40 ft. erecting space and two 20 ft. bays on each side; electric crane runway, 27 ft. high, and supports 20 tons; Whiting foundry; 8-ton electric crane;

Bevel Gear Calculations.

BY J. H. WRIGHT.

The usual method of calculating the dimensions of bevel and miter gears required by the machinist in preparing the blanks are somewhat cumbersome and necessitate several references to trigonometrical tables, which to many draftsmen who do not regularly use these tables is a disadvantage, as a lack of confidence is felt in the results. In the following method the reference to tables is reduced to a minimum, only one reference, to a table of tangents, being necessary.

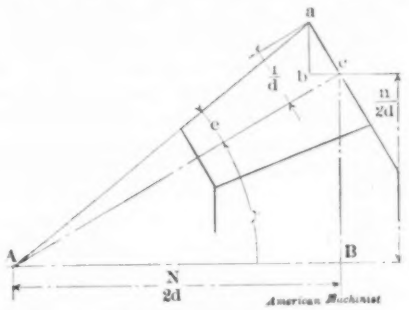


FIG. 1. DIMENSIONS OF BEVEL GEARS.

In estimating the addendum angle the similarity between the tangent of a small angle to the measure of the angle in radians is taken advantage of, the error in the case of a pinion with, say, 12 teeth being so small as to make the method commercially exact and well within the limits of accuracy of the graduations on lathe slides.

The usual data being assumed—*i. e.*, number of teeth in pinion and wheel, diametral pitch and face—the ratio R of the gears is first found, the reciprocal of which $\frac{1}{R}$ is the value of the tangent of the angle γ between the axis and pitch cone generator of the pinion, the angle γ in degrees being found by referring to a table of tangents, or, as the angle is always less than 45 degrees, it can be found directly on the ordinary slide rule. To obtain the addendum angle e, Fig. 1, first in circular measure, the addendum $\frac{1}{d}$ is to be divided by the length of the generator of the pitch cone whose length

$$AC = \sqrt{\left(\frac{N}{2d}\right)^2 + \left(\frac{n}{2d}\right)^2}$$

$$= \frac{n}{2d}\sqrt{R^2 + 1}.$$

For the angle e in radians we have:

$$e^{rad} = \frac{1 \times 2d}{d \times n\sqrt{R^2 + 1}}$$

$$= \frac{2}{n\sqrt{R^2 + 1}}$$

and, as 1 radian equals 57.3 degrees,

$$e^{0} = \frac{2 \times 57.3}{n\sqrt{R^2 + 1}}$$

$$= \frac{114.6}{n\sqrt{R^2 + 1}}$$

As the addendum angle is the same in both pinion and wheel the angle of the compound rest for turning the face of the gears can now be stated as $\gamma + e$ for the pinion and $90 - \gamma + e$ for the wheel.

In deciding the over-all diameter of the gears the amount to be added to the pitch diameter is found as follows: In Fig. 1 the triangle $a\,c\,b$, constructed on the addendum, is similar to the triangle $A\,C\,B$, which is a half section of the pitch cone, that is,

$$\frac{a\,b}{a\,c} = \frac{A\,B}{A\,C} = \frac{R}{\sqrt{R^2 + 1}}$$

$$a\,b = \frac{a\,c\,R}{\sqrt{R^2 + 1}} = \frac{1}{d}\frac{R}{\sqrt{R^2 + 1}}$$

Then P, the outside diameter of the pinion,

$$= \frac{n}{d} + 2\left(\frac{R}{d\sqrt{R^2 + 1}}\right)$$

$$= \left(n + \frac{2R}{\sqrt{R^2 + 1}}\right) \div d.$$

By similar reasoning W, the outside diameter of the wheel, is found to be:

$$\left(N + \frac{2}{\sqrt{R^2 + 1}}\right) \div d.$$

These formulas are collected in convenient form in the annexed table. For dealing with miter gears, which far outnumber bevels, the formulas are especially convenient, the face angle being

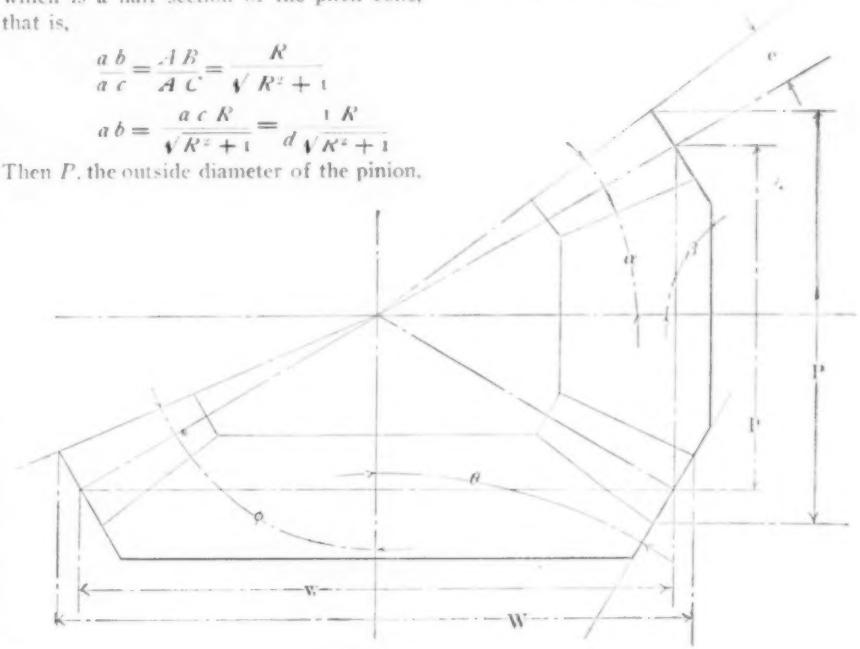
$$\alpha^\circ = 45^\circ + \frac{8.1^\circ}{N}$$

and the outside diameter being

$$(N + 1.414) \div d.$$

Example: Bevel gears 20 and 35 teeth, 4 P.

$$R = \frac{35}{20} = 1.75$$



SYMBOL	DESCRIPTION	FORMULA
N	Teeth in Gear	
n	" " Pinion	
d	Diametral Pitch	
R	Ratio of Gear	$= \frac{N}{n}$
w	Pitch Dia. Wheel	$= \frac{N}{d}$
P	" " Pinion	$= \frac{n}{d}$
W	Outside Dia. Wheel	$= \left(N + \frac{2}{\sqrt{R^2 + 1}}\right) \div d$
P	" " Pinion	$= \left(n + \frac{2R}{\sqrt{R^2 + 1}}\right) \div d$
γ	Angle whose Tan	$= \frac{1}{R} = \frac{n}{N}$
e	Angle subtended by Addendum	$= \frac{114.6}{n\sqrt{R^2 + 1}}$ Degrees
α	Face Angle, Pinion	$= \gamma + e$
β	Back " "	$= 90 - \gamma$
φ	Face Angle, Wheel	$= 90 - \gamma + e$
θ	Back " "	$= \gamma$

American Machinist

FIG. 2. FORMULAS FOR BEVEL GEARS HAVING SHAFTS AT RIGHT ANGLES.

$$\sqrt{R^2 + 1} = 2.015$$

$$\tan.^{-1}\frac{1}{1.75} = 29^\circ\ 45'$$

$$e = \frac{114.6}{20 \times 2.015} = 2^\circ\ 51'$$

giving $\alpha = 29^\circ\ 45' + 2^\circ\ 51' = 32^\circ\ 36'$.

$\beta = 90^\circ - 29^\circ\ 45' = 60^\circ\ 15'$.

$\phi = 90^\circ - 29^\circ\ 45' + 2^\circ\ 51' = 63^\circ\ 6'$.

$\theta = 29^\circ\ 45'$.

$$P = \left(20 + \frac{2 \times 1.75}{2.015}\right) \div 4$$

$$= \frac{21.738}{4} = 5.434 \text{ inches.}$$

$$H = \left(35 + \frac{2}{2.015}\right) \div 4$$

$$= \frac{35.994}{4} = 8.998 \text{ inches.}$$

Keighley, England.

The Manchester Test of High-Speed Steel.

At pages 1620, 1642, 1658 and 1747, Vol. 26, we published in full the report of Dr. Nicholson on the Manchester tests of high-speed steel. It has been regretted by many that that report contained no tabulated summary of the results, and we have pleasure in presenting herewith such a summary for which we have to thank Mr. Walter Carter, the representative in this country of Sir W. G. Armstrong-Whitworth & Company.

Notes on Cranes.

BY A. D. WILLIAMS.

The wheel base of the bridge track wheels should not be less than one-sixth the span. This has been developed by practise. A shorter wheel base causes excessive wear on the wheel flanges and a longer one is more satisfactory. The wheels carry the end carriage or truck beam which supports and connects the two girders forming the crane bridge.

There are two methods used to secure the track wheels, pressing and keying them on an axle which runs in journals, or bushing and making them a running fit on the pins. In the former case the driving gear is keyed to the axle and in the latter it is mounted upon the hub of the track wheel. Each method has its advantages and disadvantages. In the first method the axle is subject to torsion and bending, the bending stress being reversed at each turn of the wheel. The journals, however, can be placed close together, with only sufficient space between them to clear the wheel. The hubs of the track wheels need only be of sufficient length to project slightly on each side beyond the flanges, and are symmetrical, which makes it much easier for the wheel maker to get out good castings which will be free from strains and more satisfactory in service. The great disadvantage of this construction of these parts is due to the fact that their designers have never seen an M. C. B. journal box, and in their endeavor to make a journal that will hold the wheel they so arrange matters that it is necessary to jack the crane up several inches to remove the wheel and the structure is dropped so close to the runway that it is next to impossible to get a jack in. The repair gang therefore has to jack up, insert blocking and remove the jack to get out a wheel and the operation takes twice as long as it would if the parts were properly designed. An examination of the truck on any freight car would supply the necessary information to enable the designer to get up an accessible self-oiling journal of a very desirable type, from which the brasses could be easily removed or the wheel taken down with the minimum amount of trouble and bad language.

When the loose bushed wheel is used the gear must be secured to it, and while the stationary pin is only subject to bending stresses in one direction its length between supports must be sufficient to permit the withdrawal of the wheel and attached gear. With this construction it suffices to lift the weight off the wheel, which can be rolled out as soon as the pin is withdrawn, provided no complications have arisen. The gear is usually keyed to the hub of the track wheel. It is very difficult to secure first-class castings in either chilled iron or steel wheels when long hubs are cast on. The shrinkage strains set up

NAME OF FIRM	BRAND OF STEEL USED	NOMINAL DEPTH OF CUT AND TRAVERSE	TESTS ON CUTTING FORGED STEEL. SOFT Time Allowed 30 Mins.				MEDIUM Time Allowed 30 Mins.				HARD Time Allowed 30 Mins.				TESTS ON CUTTING CAST IRON. SOFT Time Allowed 30 Mins.				MEDIUM Time Allowed 30 Mins.				HARD Time Allowed 30-60 Mins			
			Actual Cutting Speed Feet Per Min.	Total Weight Removed Lbs.	Time Cutting Mins.	Condition of Tool at End of Test	Actual Cutting Speed Feet Per Min.	Total Weight Removed Lbs.	Time Cutting Mins.	Condition of Tool at End of Test	Actual Cutting Speed Feet Per Min.	Total Weight Removed Lbs.	Time Cutting Mins.	Condition of Tool at End of Test	Actual Cutting Speed Feet Per Min.	Total Weight Removed Lbs.	Time Cutting Mins.	Condition of Tool at End of Test	Actual Cutting Speed Feet Per Min.	Total Weight Removed Lbs.	Time Cutting Mins.	Condition of Tool at End of Test	Actual Cutting Speed Feet Per Min.	Total Weight Removed Lbs.	Time Cutting Mins.	Condition of Tool at End of Test
ARMSTRONG-WHITWORTH	"AW" HIGH-SPEED	$\frac{1}{8}" \times \frac{1}{16}"$	193.0	13.75	7.5	Failed	109.0	20.25	30	2	52.5	21.75	30	1	101.5	37.25	30	1	50.7	18.25	30	2	26.4	12.87	30	1
" "	"	$\frac{1}{8}" \times \frac{1}{16}"$	111.0	82.75	90	1	67.5	77.25	30	1	40.0	46.0	30	3	99.0	95.0	30	4	40.3	38.5	30	2	20.5	33.5	30	1
" "	"	$\frac{1}{8}" \times \frac{1}{4}"$	74.0	104.75	20	4	48.5	104.0	30	1	30.8	69.0	30	2	66.2	131.5	30	4	33.1	67.0	30	1	21.0	88.0	60	1
" "	"	$\frac{1}{8}" \times \frac{1}{4}"$	54.5	147.0	90	2	39.0	165.75	30	3	20.8	92.75	30	2	55.5	223.7	30	6	27.7	46.5	15	Failed	18.0	76.0	30	2
AVERAGE			78.0	87.56	16.87	3.5	66.0	94.31	30	1.75	36.0	57.87	30	2.0	78.0	134.37	30	3.75	34.5	42.56	26.2	3	25.4	52.6	37.5	1.25
SAMUEL BUCKLEY	"BOHLER" RAPID"	$\frac{1}{8}" \times \frac{1}{16}"$	106.0	27.75	30	1	105.0	42.5	30	1	59.5	25.5	29.3	Failed	112.0	25.5	30.5	Failed	51.8	19.25	30	1	31.1	4.75	13.2	Failed
" "	" "	$\frac{1}{8}" \times \frac{1}{16}"$	108.0	29.0	7.25	Failed	89.5	34.0	10.0	Failed	41.2	51.25	30	1	80.2	38.0	9.0	Failed	48.0	52.0	30	1	28.7	28.0	30	2
" "	" "	$\frac{1}{8}" \times \frac{1}{4}"$	38.73	60.5	30	1	54.1	89.75	21.25	Failed	30.7	41.25	16.9	Failed	62.0	116.25	26.8	Failed	50.0	4.25	1.4	Failed	20.8	63.25	60	5
" "	" "	$\frac{1}{8}" \times \frac{1}{4}"$	28.9	90.75	30	1	36.0	160.0	30.0	1	18.7	90.75	30	2	49.0	218.5	30	1	34.3	99.5	30	1	18.4	61.25	30	4
AVERAGE			53.2	52.0	16.81	1.75	52.4	81.56	22.8	3.5	33.8	52.18	26.5	2.5	51.2	95.8	31.5	3.75	31.8	43.47	22.6	2.5	15.1	39.31	33.3	4.25
JOHN BROWN & CO	"ATLAS" S. H.	$\frac{1}{8}" \times \frac{1}{16}"$	163.5	11.75	6.0	Failed	102.0	41.25	30	6	69.75	20.25	30	1	107.0	37.75	30	4	62.0	7.0	13.0	Failed	36.5	14.5	30	4
" "	"	$\frac{1}{8}" \times \frac{1}{16}"$	98.6	19.0	5.33	Failed	74.7	89.25	30	5	42.5	13.0	6.9	Failed	99.0	3.0	1.3	Failed	48.9	1.75	1.0	Failed	30.5	28.75	30	6
" "	"	$\frac{1}{8}" \times \frac{1}{4}"$	63.5	88.25	20.0	2	49.4	50.25	12.7	Failed	31.9	13.5	6.8	Failed	61.5	98.5	25.0	Failed	30.3	18.5	10.0	Failed	20.2	51.5	60	3
" "	"	$\frac{1}{8}" \times \frac{1}{4}"$	30.7	150.0	30	2	37.9	120.75	21.6	Failed	20.0	82.75	30	5	53.0	209.0	30	6	25.3	26.0	10.0	Failed	17.3	71.75	30	9
AVERAGE			47.6	67.3	13.88	4.25	56.6	75.35	23.8	5.0	21.7	32.6	18.4	3.0	53.8	86.0	21.6	5.25	11.7	13.3	8.5	3.25	25.3	49.1	37.9	3.0
CHARLES CAMMELL & CO	"SPECIAL S. H."	$\frac{1}{8}" \times \frac{1}{16}"$	149.2	34.5	20	2	104.5	39.25	30	2	54.0	14.75	19.0	Failed	109.0	39.0	30	1	68.5	8.5	10.3	Failed	38.6	14.0	30	1
" "	" "	$\frac{1}{8}" \times \frac{1}{16}"$	121.0	27.25	6.16	Failed	80.0	95.0	30	2	60.5	32.75	19.6	Failed	82.1	91.75	30	1	50.2	9.5	5.6	Failed	31.9	38.5	30	2
" "	" "	$\frac{1}{8}" \times \frac{1}{4}"$	61.0	83.25	30	2	61.2	42.25	9.0	Failed	32.6	60.5	24.4	Failed	72.0	93.0	30	4	31.9	67.25	30	2	25.0	86.25	60	3
" "	" "	$\frac{1}{8}" \times \frac{1}{4}"$	37.3	112.0	20	2	38.5	95.25	18.25	Failed	20.0	90.0	30	1	43.8	186.0	30	1	25.6	21.75	7.2	Failed	18.1	76.25	30	1
AVERAGE			71.2	64.25	16.54	2.75	56.6	67.93	21.8	3.75	27.5	49.5	23.28	2.75	76.7	102.4	30	1.75	17.7	24.2	13.3	3.5	28.4	53.7	37.5	1.75
THOMAS FIRTH & SONS	"N F K SPEEDICUT	$\frac{1}{8}" \times \frac{1}{16}"$	128.0	27.75	20	5	105.2	45.0	30	2	46.8	16.25	30	1	107.0	19.0	14.9	Failed	56.8	13.0	19.7	Failed	36.0	13.26	30	4
" "	"	$\frac{1}{8}" \times \frac{1}{8}"$	93.5	64.5	20	1	81.6	85.0	26.75	Failed	40.6	48.75	30	1	99.5	108.5	30	4	44.2	12.0	8.4	Failed	31.8	14.75	13.0	Failed
" "	"	$\frac{1}{8}" \times \frac{1}{4}"$	66.6	93.0	20	4	51.5	91.0	23.3	Failed	30.0	21.75	10.0	Failed	64.0	126.25	30	2	34.4	58.0	26.8	Failed	24.7	97.25	60.0	7
" "	"	$\frac{1}{8}" \times \frac{1}{4}"$	52.5	134.0	20	2	36.6	147.25	27.0	Failed	20.0	86.75	30	5	53.2	220.0	30	1	22.0	88.5	30	1	22.0	98.0	30	4
AVERAGE			85.1	71.7	20	3.0	62.6	90.8	26.7	5.25	29.3	43.4	25.0	2.25	67.0	118.4	26.2	3.0	25.6	42.9	21.2	2.75	24.2	85.3	33.2	5.25
SAMUEL OSBORN & CO	"Mushet High-Speed"	$\frac{1}{8}" \times \frac{1}{16}"$	114.0	26.5	20	2	93.0	36.0	30	2	56.2	21.0	30	4	103.5	11.75	16.0	Failed	69.0	1.0	1.8	Failed	37.5	12.87	30	6
" "	" "	$\frac{1}{8}" \times \frac{1}{16}"$	83.0	58.0	20	1	70.5	80.25	30	3	38.8	36.0	23.0	Failed	84.7	92.25	30	1	49.8	12.75	8.1	Failed	29.5	30.0	30	3
" "	" "	$\frac{1}{8}" \times \frac{1}{4}"$	72.8	95.5	20	4	49.9	110.5	30	3	29.9	44.75	18.8	Failed	58.2	125.25	30	1	34.4	60.75	17.3	Failed	20.1	23.1	17.0	Failed
" "	" "	$\frac{1}{8}" \times \frac{1}{4}"$	49.3	133.0	20	2	37.5	164.0	30	4	20.1	93.0	30	4	48.5	201.0	30	1	25.1	17.0	3.7	Failed	Tool Refused to Start	—	—	Failed
AVERAGE			79.8	60.0	20	2.25	62.7	97.7	30	2.75	31.2	48.7	25.4	3.5	61.6	107.5	26.3	2.25	10.5	17.87	8.2	3.25	15.5	16.5	19.2	5.0
SKEEBOHM & DIECKSTAHL	"Bro-Crystal" High-Speed	$\frac{1}{8}" \times \frac{1}{16}"$	124.5	28.0	17.83	Failed	93.5	37.5	30	6	59.1	13.5	21.7	Failed	103.5	38.0	30	1	59.7	20.75	30	4	38.4	14.0	30	1
" "	" "	$\frac{1}{8}" \times \frac{1}{16}"$	100.9	6.25	1.58	Failed	66.5	78.25	30	4	43.5	20.25	12.2	Failed	71.0	76.25	30	1	51.2	30.75	17.9	Failed	30.1	31.25	30	2
" "	" "	$\frac{1}{8}" \times \frac{1}{4}"$	82.2	33.25	10.58	Failed	51.4	116.25	30	2	26.9	23.0	11.1	Failed	60.9	86.75	21.0	Failed	36.6	28.0	12.0	Failed	24.7	85.75	60	3
" "	" "	$\frac{1}{8}" \times \frac{1}{4}"$	38.3	110.5	20.0	7	38.6	146.75	30	2	17.6	73.0	30	7	53.2	219.7	30	5	25.4	23.75	9.0	Failed	19.6	79.5	30	4
AVERAGE			46.2	62.3	12.5	7	62.5	99.7	30	3.5	22.0	33.4	18.7	4.5	67.3	105.1	27.7	2.75	27.9	25.8	17.0	2.75	25.1	52.6	37.5	1.25
VICKERS SONS & MAXIM	"High-Speed Steel"	$\frac{1}{8}" \times \frac{1}{16}"$	132.5	99.0	30	2																				
" "	" "	$\frac{1}{8}" \times \frac{1}{16}"$	106.4	29.5	6.6	Failed																				
		$\frac{1}{8}" \times \frac{1}{4}"$																								
		$\frac{1}{8}" \times \frac{1}{4}"$		Retired from Further Trials.																						

TABLE I. SUMMARY OF DR. NICHOLSON'S TESTS ON HIGH-SPEED STEEL AT THE MANCHESTER MUNICIPAL SCHOOL OF TECHNOLOGY.

may show at once, altho at other times they do not show till after use. With steel wheels irregularities in the runway will result in gradually rolling the flanges of the wheel over and forcing the driving gear into the end carriage. If chilled wheels are used, the flange is spawled off and the gear forced over. When this occurs it is much easier to remove a gray-iron gear and wheel than to get out a steel gear and wheel. The first can be knocked to pieces with a sledge and very little chipping, while the last requires lots of chipping and sledging and perhaps the assistance of a ratchet drill. If the end carriage is of gray iron, as it is on many cranes, care must be used not to smash it, or a nasty job of patching will be required to put it in shape. If the end carriage is built up of steel, a new cast washer can be put in and the repairs do not take as long. Some may object that the runway should be kept in shape, to which the answer is that the crane could be easily designed to avoid any such trouble.

The end carriage as generally designed is a simple box girder of gray iron, or is built up of steel. It is supported by the track wheels and has two equal loads symmetrically placed. For light cranes of long span, it is occasionally desirable to avoid the use of idler gears between the squaring shaft and track wheels, which can be done by placing the truck beam unsymmetrically with regard to the girders, throwing the greater portion of the load on the driving wheels. The end carriages should be rigidly secured to the two bridge girders to hold them square with the runway and this connection takes the racking strains due to uneven track wheels or to one end lagging behind the other. With gray-iron carriages the seats are usually planed and have projecting lugs on each side between which the girders fit, black bolts and dowels and in some cases turned bolts being used. With steel carriages turned bolts are usually used. Gusset plates or lateral bracing of any kind is conspicuous by its absence, and the machine is not often in line. The connection is made entirely thru the lower chord and top chord is rarely braced or stayed in any way except by the stiffeners. The slightest play in this connection permits working, and it is not very long before it gets thoroughly limbered up.

In the days of plate girders the pair composing the bridge were often tied together at the ends by a short box or channel girder, a cast track wheel bracket being used. The vertical load was carried by a heavy plate on the outside of the girders resting on a planed seat on the bracket. The brackets were secured to the bridge by heavy bolts, the lower bolts being, preferably, double ended, passing completely thru the bridge and tieing the two brackets at that end together. It was very easy to bring these brackets home by heating the body of the bolts before tightening up the nuts and they stayed put. This construction can be used with box girders, and if M. C. B. journal boxes are used it makes a very neat and substantial structure.

On heavy cranes eight track wheels are required, four at each end, and it is desirable to distribute the load as uniformly as possible; this necessitates the use of some form of equalizer in which the wheels are mounted in pairs. One form of construction employs heavy cast trucks, pin connected to the truck beam. In another type each girder is mounted on an independent truck beam carrying a pair of wheels, the two girders being tied together by a horizontal plate which will resist racking and hold them in line, but sufficiently flexible to deflect for all vertical inequalities in the runway. A third construction is a modification from railroad car practise, a form of center bearing being used. The driving gears, when equalizers are used, must be so laid out that there will be no chance for the movement of the equalizer to throw the gears out of mesh or crowd them together. The movement is normally very small, but there are latent possibilities for mischief to be allowed for.

The squaring shaft should be driven at its center so that the torsional deflection in its two segments will be equalized and the brake should also be placed at this point. If it is desired to locate the motor close to the end of the bridge, a first motion shaft driven by the motor should be used to transmit the power to the center of the span. The squaring shaft is supported by bearings, usually lined with babbitt metal, and in lining it up the girders should be supported at their ends only and the trolley or an equivalent weight should be located at the center of the span to produce as near as may be running conditions. The girders will deflect more or less under load, which bends the shaft. In scraping the bearings the caps or upper half should be relieved a trifle to reduce their tendencies to bind.

NAME OF FIRM	BRAND OF STEEL USED	Total Number of Trials	Number of Successful Trials	Number of Times Tool Failed	Total Time Lost Thro Failure of Tools Mins.	Average Time Lost on Each Test Mins	Total Wt. of Metal Removed During all Trials Lbs.	Average Condition of Tool Edge After Trial Low Nos. Indicate Superiority
ARMSTRONG-WHITWORTH	"A.W." High Speed	24	22	2	27.5	1.15	1827	2.54
SAMUEL BUCKLEY	BOHLER-RAPID" Self-Hard	24	14	10	134.3	5.62	1458	3.04
JOHN BROWN & CO.	"ATLAS" Self-Hard	24	12	12	218.9	9.12	1299	4.04
C. CAMMELL & CO.	"SPECIAL" Self-Hard	24	15	9	140.2	5.85	1445	2.54
T. FIRTH & SONS	N.F.K. SPEEDICUT.	24	15	9	100.1	4.17	1722	3.58
SAMUEL OSBORN & CO.	"MUSHET" High Speed.	24	15	9	192.1	8.01	1466	3.2
SEEBOHM & DIECKSTAHL	"NEW CAPITAL" High Speed	24	14	10	135.7	5.66	1447	3.83
VICKERS SONS & MAXIM	"HIGH SPEED STEEL"	2	1	1	Retired from further trials			

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TABLE 2. CONDENSED SUMMARY OF TABLE I.

Worthless Data.

We take the following from the address of Carroll D. Wright, as retiring president of the A. A. A. S.

MATERIAL		Carbon %	Silicon %	Manganese %	
STEEL	SOFT	0.198	0.055	0.605	
"	MEDIUM	0.275	0.086	0.650	
"	HARD	0.514	0.111	0.792	
CAST IRON	SOFT	Sulphur % 0.031	Silicon % 3.010	Manganese % 1.180	Combined Carbon % 0.459
"	MEDIUM	0.061	1.793	0.588	0.585
"	HARD	0.161	1.739	0.348	1.15

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TABLE 3. ANALYSIS OF MATERIALS OPERATED UPON.

Dr. Karl Pearson, of University College, London, states that a man of mediocre ability can observe and collect facts, but that it takes the exceptional man of great logical power and control of method to draw legitimate conclusions from them. He thinks that at least 50 per cent. of the observations made and the data collected are worthless, and that no man, however able, could deduce any result at all from them; that, in the language of engineers, we need to "scrap" about 50 per cent. of the products of nineteenth-century science; that the scientific journals teem with papers which are of no real value at all, recording observations that cannot be of service to anyone, because they have not been undertaken with a due regard to the safeguards which a man takes who makes observations with a view of testing a theory of his own; that in other cases the collector or observer is hopelessly ignorant of the conditions under which alone accurate work can be done; that such a man piles up observations and data because he sees other men doing it, and because that is supposed to be scientific research.

The amateur patternmaker is quite likely to experience trouble in his first attempt at mixing lampblack and shellac, owing to the tendency of the former to form lumps, thus preventing a thorough mixture of the two ingredients. If the lampblack is first made into a soft paste with alcohol, thoroughly working out the lumps with a wooden or metal spatula, the shellac can then be added and a smooth working shellac will result.—*Amateur Work.*

Impact Tests on Wrought Steels.*

BY E. A. SEATON AND A. JUDE.

The objects of this paper are to show some of the characteristics and peculiarities of the wrought steel as supplied by steel manufacturers for commercial purposes; to assist in the development of a more rational method of testing the suitability of such steels for each particular purpose of the engineer; and to point out a few of the peculiarities that are observed in the fracture of test specimens and actual pieces of machinery. It is, in fact, the outcome of the constant endeavor of engineers to avoid the use of material which might be dangerous in the construction of machinery liable to severe alternating stresses and more especially to attempt to find the very best steel for those parts liable to shock, owing to the inability to make those parts larger in the very fast moving engines so much in demand to-day.

Considerable movement has been made of late toward the establishment of a shock test for steel, conducted on a smaller scale than is the custom with axles; for instance, where the full sized article is tested. The authors are strongly of opinion that progress in this direction is taking place still too slowly, and it is therefore the aggregate object of this paper to help toward a further appreciation of this valuable test. All the experiments have been made on the ordinary steel as supplied by various manufacturers as suitable for such parts. Some of the test pieces are from forgings, such as crankshafts, connecting rods, etc., and others from the bar-steel supplied for stud and bolt making. In no case have they dealt with what may be called a "fancy" material, the product of laboratory melting pots. The tensile tests have been made in a Buckton testing machine, while the shock tests have been carried out in an apparatus designed by the authors to require, as a rule, more than one blow to produce fracture. Such apparatus, as shown in Fig. 1, consists essentially of a weight of 6 pounds, arranged to drop freely thru 24 inches on to the test-bar, Figs. 2 and 3, which rests on fixed supports 3 inches apart. The test-bar is 4 inches long, so that there is half an inch overlap at each end. After each blow the test piece is reversed. In the authors' opinion the apparatus to test the endurance of a material under shock should not be one in which the sample is fractured at the first blow, especially for steels that are soft and are really very tough, altho they admit that for some purposes such a test may be instructive, and actually necessary for very high carbon steels. For constructional purposes the engineer is not greatly concerned with steels with more than about 0.4 per cent. carbon. Altho a large number of experiments have proved to them that in every case, and with every description of structural steel, the power to resist shock has been materially enhanced by oil tempering, they have confined themselves mainly to the examination of the material as supplied by the makers rather than after any heat treatment of their own.

*Abstract of a paper read before the British Institution of Mechanical Engineers.

TENSILE TESTS ARE INADEQUATE FOR PARTS SUBJECT TO SHOCK.

At present everybody makes tension tests, and trusts more or less to them alone. One takes up an advertising or scientific article on, say, "Special Nickel Alloys of Steel," suitable for doing all sorts of wonderful things, and the first and the main thing one is expected to be impressed with is the superior tensile and elongation results. One has occasionally yielded to the temptation to use such steels for which a very big price has been paid, but they have usually proved no better servants than ordinary material. A large majority of engineers rest content with tension tests alone, no matter to what use they are putting the steel; some, perhaps, because it is rather an expensive test, taking into consideration cost of plant, etc. It is sometimes stated, consequently, that an ordinary mild steel (say "Admiralty" grade) is not good for certain purposes, but that a particular "special' steel is perfectly safe, etc., *because the elastic limit and tensile strength are somewhat better.*

	Per cent.
Constant tension	3.91
Constant tension and compression $\left(\text{range} \frac{0}{\text{max.}}\right)$	1.30
Constant tension and shock	48.80
Alternating tension and compression with shock	2.81
Repeated tension (from a constant to max.) with shock	36.00
Miscellaneous and doubtful	7.17
	100.00

TABLE I. STRESSES IN THE STEEL PARTS OF AN ENGINE.

A similar assertion is made in the Sixth Report to the Alloys Committee in reference to heat-treated steel for guns. How much is this tensile strength and elastic limit thereby raised? The answer is—anything from about 5 per cent. to 30 per cent.

This increased percentage must be a mere trifle for such articles as are subjected to stresses or shocks of an unknown effective magnitude, and it seems absurd to say that the difference between danger and security in a gun is ever met by 30 per cent. increase in the quality of the steel.

But, nevertheless, it is certain that such treated steel is suitable for its purpose, and it is evident therefore that something far more important has been contributed to the original qualities of the material than the mere improvement in tensile properties to account for it. To anticipate a little, it is because the shock strength is improved several hundred per cent., as against the insignificant increase of, say, 30 per cent. at most in the tensile strength and elastic limit.

Attention may be drawn to the analysis of stresses in the steel parts of an up-to-date steam engine of moderate size given in Table 1.

It will be seen that 87.6 per cent. of the whole engine is subject to more or less shock, while pure tension forms an insignificant percentage of the total stress; vibratory or alternating stress where the transition from one kind to another is gradual (say, following a sine law), and unaccompanied by shock, does not occur at all in normal conditions, altho it may be conceded that under ideal conditions—in the crankshaft, for instance—it will occur. This is in only one machine. If, however, various other machines are examined, it will be found that nine out of ten are working under similar conditions.

Referring again to the steam engine, there are important parts, such as the piston rods and connecting rods, that, under ideal conditions of working, are subject mainly to direct alternating stresses. When in the majority of cases a piston rod gives way, it breaks at the end thru the line *A B*, Fig. 4, and not thru the smallest area *C D*, supposing that happens to be less than the area at the bottom of the thread. In fact, it is dislocated thru a section where the effect of repeated blows can accumulate. There is undoubtedly, in addition to the suddenly applied steam loads, a series of true tho comparatively minute blows (with proper adjustment) arising from the necessary slackness in all the bearings.

There are exhibited portions of some broken studs in which the working stress probably never exceeded 2¾ tons, and certainly could not by the most extreme method of calculation have exceeded 4¾ tons per square inch. Some examples are shown in Fig. 5, and to which the same remarks apply. The stress given above is the maximum, and the variation of stress was from the initial "nip-up" to this value. In no case did the rate of variation exceed 350 per minute, and the stresses were in all cases variable (that is, of the same sign) and not alternating (from + to —). The total number of variations in six particular cases of the broken studs was as follows:

A	3,240,000
B	7,000,000
C	1,240,000
D	2,800,000
E	5,700,000
F	15,400,000

which represents after all only a short life of a few days in the case of some modern engines. From consideration of the relative speeds at which the variations were made, and the limiting condition as deter-

mined by the diagram, much more ought it to be impossible to break these studs by the mild "varied stress" treatment actually meted out to them. From the above two considerations it would appear reasonable to conclude that the effect of alternating or variable stresses of the magnitudes determined by the usual factors of safety, and especially in those cases where the stress is nearly if not quite uniform over the whole area (as distinguished from those cases where it varies, as in a beam from 0 to a maximum at the surface) is quite harmless. Something of a more *searching* nature must be looked for, and it seems as if it can only be *shock*, that is, a number of minute blows more or less persistently applied.

UNACCOUNTABLE FAILURES.

There have no doubt been many cases where mild steel forgings of this kind have to all appearances broken in an unaccountable way. In some cases under the authors' notice the shanks of studs have been reduced very considerably, so that the area was only about one-half that at the bottom of the thread. Yet, without a single exception, they all broke thru the thread. In fact, some one or two of such studs have had for unavoidable reasons a larger thread at one end than at the other, but they broke thru the larger thread and not thru the smaller thread. More curious still, in at least three cases under their notice, a complete annular ring has broken between two adjoining threads; and further, these threads rarely break at the ends of the nuts, but in various places, often somewhere in the middle. In the case of those cut up for testing, the usual tensile tests were quite satisfactory, and in one or two where an analysis was taken of the metal close to the fractured surface, it was also quite satisfactory. But on being subjected to an impact test they all gave exceedingly poor results. For instance: A broke after only 1 blow, B broke after only 13 blows, C broke after only 9 blows, D broke after only 7 blows.

From numerous tests it is found that the average impact strength with this particular machine (Fig. 1) for "Admiralty" mild steel, *ordinary* forging quality, is equal to about 20 blows. This would be for articles having scantlings of a few pounds. The maximum for the grade and similar scantlings may be taken at about 30. Thus, all these test specimens from broken articles gave results considerably below the expected average.

There is yet another point in favor of the contention that failure is by shock and not by true alternating or variable stresses. It is well known that the resistance to alternating stress (rotation method) *increases* with the carbon content and elastic limit of the steel, but the resistance to shock *decreases* with an increase in those factors (for "normal" steel) to an extent that will be explained later.

It has been found in a large number of instances that where fracture has occurred after a few hours' work when using normal medium grade steel (0.25 to 0.3 C.), this occurrence has been either greatly delayed or indefinitely postponed by the substitution of low-carbon steel, especially when in its best toughened (fine grained) condition. Therefore, apart from the question whether even thirty blows given by this particular machine is a good and sufficient insurance against fracture, the point is that it is not satisfactory to subject all steel to one particular test just because that test may be a suitable one for large quantities of it for one particular purpose. Let there be these particular tests for bridge steel and boiler steel by all means, but steel that will be used for the miscellaneous forgings of machinery in general should be tried by its own crucial tests. Car axles, cranks, and similar articles, perhaps, should be subjected to an alternating stress by the rotation method instead of by the shock test, as in their case also the tension test is almost useless as a gage of the suitability of the material. Professor Ewing and others have shown most conclusively that the resistance to an alternating stress of the kind adopted in their researches bears no relation to the resistance to pure tension.

There is every reason to believe that the desire for a high-tension steel, so that with the usual factors of safety a high tensile strength may be available, is to a great extent a mistaken one. Nor is this to be regretted, seeing that requirements can be more fully and safely met by a comparatively low-tension material if a lower factor of safety were permitted, on it being shown by suitable tests that it is more reliable.

It must not be concluded that the factors of elastic limit, etc., are despised, but since the forces that cause breakage are in practise far below the elastic limit in magnitude, and moreover, as the factor of safety is quite arbitrary and the same in no two pieces of machinery, it seems to the authors that the cart is put before the horse to a great extent. In fact, under the usual conditions of design one knows enough about the elastic limit which can only vary in a given grade of steel between comparatively small and insignificant limits, whereas the shock strength can vary almost between infinite limits.

THE IMPACT TEST.

Opinions differ as to the best means of making the impact test, but, on the whole,

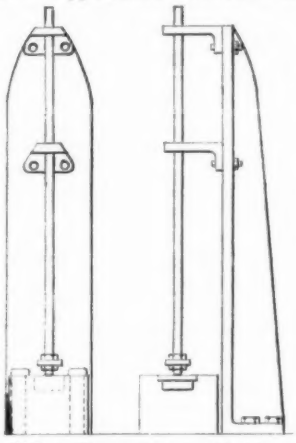


FIG. 1 "Impact" Testing Machine

FIG. 2 "Impact" Test Bars

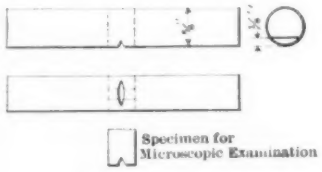


FIG. 3

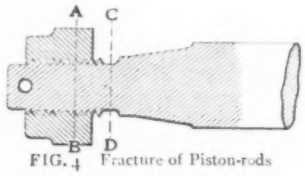


FIG. 4 Fracture of Piston-rods

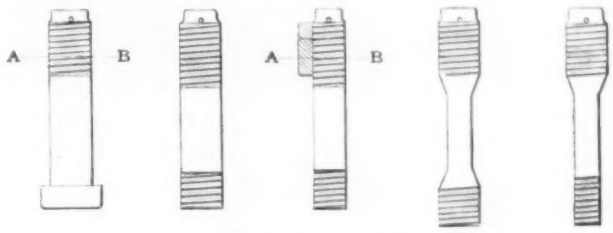


FIG. 5 Fracture of Studs

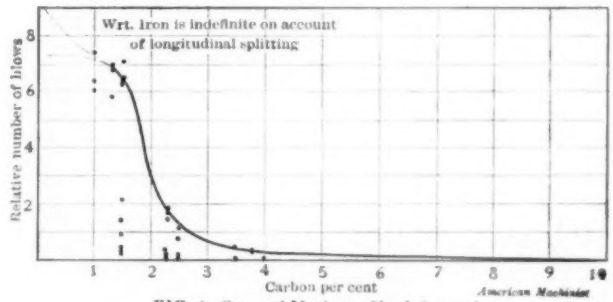

Wrt. Iron is indefinite on account of longitudinal splitting
Relative number of blows
Carbon per cent
American Machinist

FIG. 6 Curve of Maximum Shock Strength of Commercial "Pearlitic" Steels (Forged or Rolled Quality)

IMPACT TESTS OF WROUGHT STEEL.

the consensus of opinion appears to be that it should be made with a machine that breaks at one blow, and at the same time measures the energy expended in breaking the specimen. M. Frémont thinks that breaking by a series of blows gives results that are similar to those from a static bending test; that is, they are more a gage of ductility and tensile strength than of resistance to shock. The authors are not with him in this opinion, provided that the blows are not heavy enough to produce material bending; it is possible that he means in this sense, much in the same way as Heyn adopted in a series of experiments on the "overheating of mild steel." Here he had a nicked bar with one end stuck in a vise. A blow was given by a hammer, bending it over to a right angle. A reversed blow knocked it back again, and so on until fracture occurred. This is not the method the authors have adopted, for with the weight and size of specimen used the bending is very small indeed even for the softest steels.

From the very many bars that have been tested by them they have found the number of blows to produce fracture is a fair gage of the toughness or anti-brittleness. But there is no relation whatever between this result and the tensile results except what has previously been mentioned, viz., that if the impact result is good the elongation is sure to be good, too; but, on the other hand, a steel showing high tensile strength and good elongation may be useless to resist shock, as shown in Table 2.

		Tension	Elongation	Impact
		Tons per sq. in.	Per cent. on 2 in.	Blows.
Cold drawn bar of very low (less than 0.1) carbon steel.	(a)	31.63	31	1
	(b)	31.27	20	180
Low carbon steel (0.15 C.)	(a)	28.3	35	175
	(b)	27	33	5
Medium carbon steel (0.25 C.)	(a)	36.5	35	5
	(b)	36.5	35	27
Mild cast steel (0.35 C. about)	(a)	29.18	22.7	1
	(b)	28.25	31	1

TABLE 2. COMPARISON OF TENSILE AND IMPACT TESTS.

Altho there is no relation between the tensile-stress test and the alternating-stress test, or between the tensile test and the shock test, the authors are not prepared to say that there is no relation between the alternating-stress test and the shock test. They will, indeed, be glad to learn that there is a close relation, since then the controversial ground as to the nature of the forces—"alternating" or "shock"—is at once eliminated. They think it possible that a relation does exist, because, altho there are differences in the disturbance of the metal in the vicinity of the fracture, the radical phenomena ("dislocation" and "cleavage") are the same.

It has been said previously that the maximum shock strength for the particular grade of steel containing 0.25 per cent. of carbon is about thirty blows, as gaged by the authors' machine. Altho thirty may be a fair figure, such steel cannot be relied upon to give this always. More than thirty blows is rarely reached with this steel in its normal condition, while it is a very common occurrence for the number to be considerably below this. Similar remarks apply to steels of other grades. With the usual factors of safety considered by authorities to be sufficient, they find that for those parts subjected to more or less shock, there is a grave risk of them breaking under the modern conditions of high speeds. The authors have no hesitation in venturing the opinion that the comparative immunity from failure that does exist in machinery is due to the liberal data on which the designer usually bases his calculations and to the "extra allowance for practical purposes" that creeps in all designs, thus bringing up the real factors of safety to a figure considerably higher than that primarily intended to be used. If, however, the increasing desire to keep scantlings down to a minimum is to be realized, security can only be obtained by insuring that the steel used shall have the maximum shock strength for its grade.

Further, the majority of steel users require that they shall be able to use an ordinary steel as supplied to them, and without annealing, tempering, or other heat treatment. The authors, therefore, urge that the engineer should demand of the steel maker a greater attention on his part to produce and supply the ordinary grades of steel with a more uniform "shock" quality.

It is, of course, to be expected that brittleness in steel increases with the carbon content, but the authors are convinced that the falling off in this respect is far more rapid than the majority of engineers are aware of. And, further, they believe that this has been in a great measure unobserved, owing to the prevalence of the tensile as the only test; and they are also led to this by the fact that the very toughest "fancy" steels (as distinguished from the natural or normal pearlitic steels) are often produced from what is more or less equivalent to high carbon steels, such, for example, as the nickel alloys.

RESULTS OF EXPERIMENTS.

From the results of numerous experiments they arrived at the results shown in Fig. 6, which gives approximately relative values of minimum brittleness or maximum toughness under shock. For instance, it may be expected that with articles of approximately the same scantlings and in their pearlitic condition, those having 0.2 per cent. carbon will be five times tougher to resist shock than those with 0.3 per cent. This diagram is intended to apply to forged or rolled steel and not steel castings, at any rate not such as usually supplied.

In the foregoing, the subject matter has been strictly confined to the strength, etc., of steel in its natural condition, or that condition produced by the comparatively slow cooling process of ordinary manufacture. The shock strength of "treated" steels, however, is a matter of equal, if not greater importance. "Treated" means any process whereby the steel is left in a more or less artificial condition as distinguished from the natural condition just discussed, such as oil-hardening, water hardening, tempering and allied processes. The authors have not had the time nor facilities for conducting a complete series of experiments with these steels, but they have done quite sufficient to be assured of the fact that the shock strength of oil-quenched mild steels particularly is not increased a mere matter of 20 per cent. (720 degrees Cent. in oil, 0.25 Cent.) to 130 per cent. (1,200 degrees Cent. in water), as is the case with the tensile strength, but on an average 500 to 600 per cent. more than the shock strength of the natural steel in its *best* condition. Moreover, oil-quenching appears to possess the highly important property of "leveling up" the shock strength of steel to a fairly constant value.

Thus there may be two similar articles made of the same grade of steel, the one coarse and brittle and the other fine and tough, and possessing a maximum shock strength. Oil-quenching will increase the strength of both to a common value, the increase in the one case being perhaps several thousands per cent. and in the other the 500 or 600 per cent. above referred to. (See Table 3.)

They think that practise with such things as gun-barrels shows this also very clearly, and they have no hesitation in saying that, whereas the tensile testing machines practically make no distinction between the steel that is utterly unfit and that which is eminently fit for the parts of a machine subject to shock or vibratory stresses, the drop-testing apparatus does most certainly, and without fail, make the discrimination; and further, that wherever the drop testing machine shows a steel to be good, the tensile testing machine corroborates it. Therefore it may be concluded that while the drop testing machine is a certain and reliable guide to the maker of such structures, it is equally the friend of the constructor of other structures, subject only to tension or compression steadily or constantly applied.

Attention is particularly drawn to the shock strength of bright rolled bar. It is a remarkable fact that, until quite recently, all the bright bar on the market, with the exception of about two British makes, appeared to be quite rotten under shock, snapping off in all cases with only two or three blows, and not improving very much by oil-quenching. The authors have not had occasion to obtain analyses of the numerous samples of bright bar they have tested, but in the majority of cases the

carbon content was stated to be from 0.11 to 0.15 per cent.

In those samples which met in other respects the Admiralty specification the shock strength was worse than that of lower grades. The reason for the generally inferior results may be due to the drastic rolling process, but the fact remains that good bars can be produced with certainty by a few makers. They are, however, glad to observe that other makers are rising to the occasion and that improvement is rapidly being effected, and without the accompaniment of a prohibitive price. They would, nevertheless, recommend due caution on the part of those using the larger sizes of bright bar for important parts of machinery. The number of blows that good bright bar will stand appears to be about the same as for ordinary bar of the same grade.

Description.	Normal Condition. Impact, No. of blows.	Maximum stress. Tons per sq. in.	Elongation per cent. on 2 inches.	Condition.	Analysis. Average per cent.	Oil-Quenched. Impact, No. of blows.	Maximum stress. Tons per sq. in.	Elongation per cent. on 2 inches.	General Remarks.
Low carbon steel.	7	—	—	—	C. 0·15 to 0·15	165	—	—	Original bars 2in. diameter. Oil-quenched in test-bar form. Impact test-bars ½in. diameter.
	5	26·9	29·8	as received	S. 0·032 to 0·056 P. 0·033 to 0·023	159	25·7	31	
Acid.	165	—	—	—	Mn. 0·63 to 0·75	177	—	—	
	163	—	—	—	Si. 0·065 to 0·057	181	—	—	
Low carbon steel.	293	23·2	46	—	C. 0·17, S. 0·051 Mn. 0·45, P. 0·044	301	27·8	35	Original bars ¾in. diameter. Oil-quenched in test-bar form. Impact test-bars ½in. diameter.
	217	26·3	49·5	as received	C. 0·017, S. 0·050 Mn. 0·065, P. 0·052	280	31·5	38	
Basic.	1	55·7	12	—	C. 0·073, S. 0·056 Mn. 0·6, P. 0·053	5	74·4	3	
Medium carbon steel.	23	32·5	35	as received	—	105	37·8	31·4	
	35	—	—	annealed in lime	C. 0·23	—	—	—	
Admiralty.	35	—	—	annealed in coke dust	S. 0·036	—	—	—	Original bars 2in. diameter. Oil-quenched in test-bar form. Impact test-bars ½in. square.
Ordinary grade.	5	—	—	as received	P. 0·058	111	—	—	
	47	—	—	annealed in lime	Mn. 0·76	—	—	—	
	5	—	—	annealed in coke dust	Si. 0·05	—	—	—	
						(a) 73	—	—	(a) ½in. square test-bars, cut from core of 3in. bar previously oil-quenched. Microstructural appearance same in core as in outer zone, showing that toughening extends to the core. (b) (c) Similar bars cut from the outer zone.
						(b) 73	—	—	
						(c) 95	—	—	
						107	32·5	34·5	Test-bars from 2¾in. oil-hardened bolts as received from makers.
						109	—	—	
Bright rolled bar	3	—	—	—	—	19	—	—	Impact test-bars ½in. diameter. Test-bars cut from ¾in. to 1¼in. bars.
	3	35·4	25·2	—	C. 0·11 to 0·15	21	29·1	39	Impact test-bars ¾in. diameter.
	1	—	—	—	—	25	—	—	
	3	—	—	—	—	31	—	—	
	183	31·9	24·5	—	—	207	—	—	¾in. diameter bar.

TABLE 3. ABSTRACTED TEST RESULTS OF VARIOUS STEELS.

The statistics of production of raw iron during 1903, just published by James Watson & Co., of Glasgow, show a total output of 45,480,000 tons. The United States led with 18,000,000 tons and Germany had second place with 10,000,000 tons; Great Britain came third with 8,800,000 tons, and in France the output was 2,800,000 tons. Production decreased in Russia, Austro-Hungary and Sweden.

The New British Patent Law.

The following account of the working of the new British patent law, which became operative with the new year, we clip from the editorial columns of *Practical Engineer*, London. The italics are ours.

"The complete specification that has to be filed at the expiration of six months from the date of provisional application will be filed in the same manner as at present, but the specification will then for the first time be subjected to an examination by means of an official search, for the purpose of determining whether the invention or any part thereof that is made the subject of a claim has been patented in England during the previous fifty years. If the search reveals anticipations, then the applicant will be informed of such, and he will be permitted to alter his claims so as to avoid the patents to which the Patent Office has directed his attention. On the other hand, should he not satisfy the examiners by the alterations thus made the comptroller will order the patent specification to be printed with a reference therein to the prior specifications that have been disclosed by the Patent Office. *The patent will not, however, be refused by the Patent Office*, so that the patentee will be in no way blocked by the Patent Office from treating his invention as a patented device, even tho the office is familiar with the weakness of the claims made by the patentee. An additional fee of one pound will be charged on the patent being sealed. The system of not refusing a patent, but allowing the patentee to take it at his own risk, provided he inserts in his specification the references that the Patent Office requires, *is considerably in advance of the American and the German and other continental practise*, where good inventions in points of detail and improvements of the highest value are constantly rejected, and patents are refused therefor, on account of old references that do not and would not affect the patent if even such were contested in a court of law. The new British patent, when issued under the 1905 practise, *will not be in any sense guaranteed as to novelty*, and no assumption that the patent can be taken as officially certified either as to validity or as to its subject matter or otherwise must arise, even altho the Patent Office has made no objection in any way to what has been claimed in the specification. We consider that the new system will be generally to the advantage of the inventor and to the public, even altho there are some curious anomalies connected with the scope of the search and the methods of examination that are to be adopted."

"Physical Characteristics of Certain Bronzes."

Succeeding the presentation at a recent meeting of the Franklin Institute of a paper bearing the above title by Strickland L. Kneass, which was printed in abstract by us beginning at page 1667, Vol. 27, the following interesting remarks were contributed by members present:

Mr. G. H. Clamer—Mr. Kneass has brought out some very interesting facts relative to alloys which may be used for steam purposes, and their manipulation in the foundry, but he failed to mention one very important factor which will produce a metal sufficiently dense to withstand the high pressures which such an alloy is called upon to resist. I refer to the admixture to such an alloy of a small quantity of lead. It has long been known by foundrymen that a mixture of a small quantity of lead will produce this effect, and, further, it facilitates the machining of castings which contain it. I know of a very interesting experience bearing on this subject, viz.:

In the time of the old bronze cannons, which were made from an alloy (known as "cannon bronze") of copper and tin, a certain founder had taken a government contract for the manufacture of quite a number of guns of this character. According to the specifications, the government inspectors were required to weigh the charges and see that they were charged in the furnaces, and then the foundryman was held responsible for the castings. These guns were subjected to certain pressure, and, after repeated failures, the manufacturers, being familiar with the value of lead in the alloy, decided to have some molds made of the exact shape in which pure tin was marketed. One night they melted the tin which they had on hand, and added a certain small percentage of lead and then poured it into the molds, and when the inspector came the next day he weighed the pigs, which he had no reason to suspect were anything else but pure tin. The mixture was then made up in the usual way, and to the utter surprise of the government officials the castings from that day all came up to the full requirements.

There has been another point mentioned by Mr. Kneass, viz., the difficulties which are sometimes encountered, due to the presence of the eutectic. What is now known by the name of "eutectic" was known to the old founders as "tin spots," and it was with the idea of removing these that the old bell founders tried various expedients, notably the addition of metallic silver, etc.

In our daily production of alloys containing copper and tin, the presence of the eutectic can be observed. In casting ingots of phosphor bronze, which contain 80 per cent. copper, 10 per cent. tin and 10 per cent. lead, its presence is very often manifested by the appearance of globules on top of the ingots. These, when subjected to analysis, are found to contain approximately 22 per cent. tin, 2 per cent. lead, 74 per cent. copper and perhaps 2 per cent. to 3 per cent. phophorus. This quite likely is a complicated quadruple eutectic. It demonstrates that phosphorus in phosphor bronze is contained almost entirely in the eutectic part of the alloy, and it is due to this that phosphor bronze is so materially harder than alloys of the same composition which do not contain it.

Prof. A. E. Outerbridge—There is one explanatory statement in Mr. Kneass' excellent paper to which I wish to offer a slight modification. He attributes the greatly increased density and finer texture of test samples of bronze cast in an iron mold, as compared with similar samples of the same bronze metal cast in a sand mold, entirely to the more rapid cooling of the metal when cast in the iron mold. I have made very many experiments in this direction, covering a period of sixteen years or more, and the result is that I attribute the phenomenon mainly to what I call "fluid compression."

You may ask what do I mean by fluid compression in this connection? I mean simply this: Certain alloys of metals expand with enormous force at the moment of solidifying. It is due to this fact that we are enabled to obtain sharp castings. Pure copper, pure silver, pure gold, etc., do not give sharp castings, because they do not expand greatly at the moment of solidifying.

When such an alloy as that referred to by Mr. Kneass is cast in a sand mold, it first fills the mold, and then when pouring has ceased it suddenly expands and forces the yielding grains of sand outward in all directions, making a larger cavity than before. A skin of solidified metal forms immediately; then contraction of the mass begins to take place, the thick sections cool more slowly than the thin sections, giving rise to "segregation" and to spongy spots or porous places, while the whole texture of the congealed metal is of coarser grain than it would have been if it had been subjected to mechanical pressure when in a plastic state.

When this alloy is cast in a metal mold the expansion at the moment of solidifying takes place as before, but encounters the rigid walls of the mold, and, therefore *fluid compression of the molecules of the*

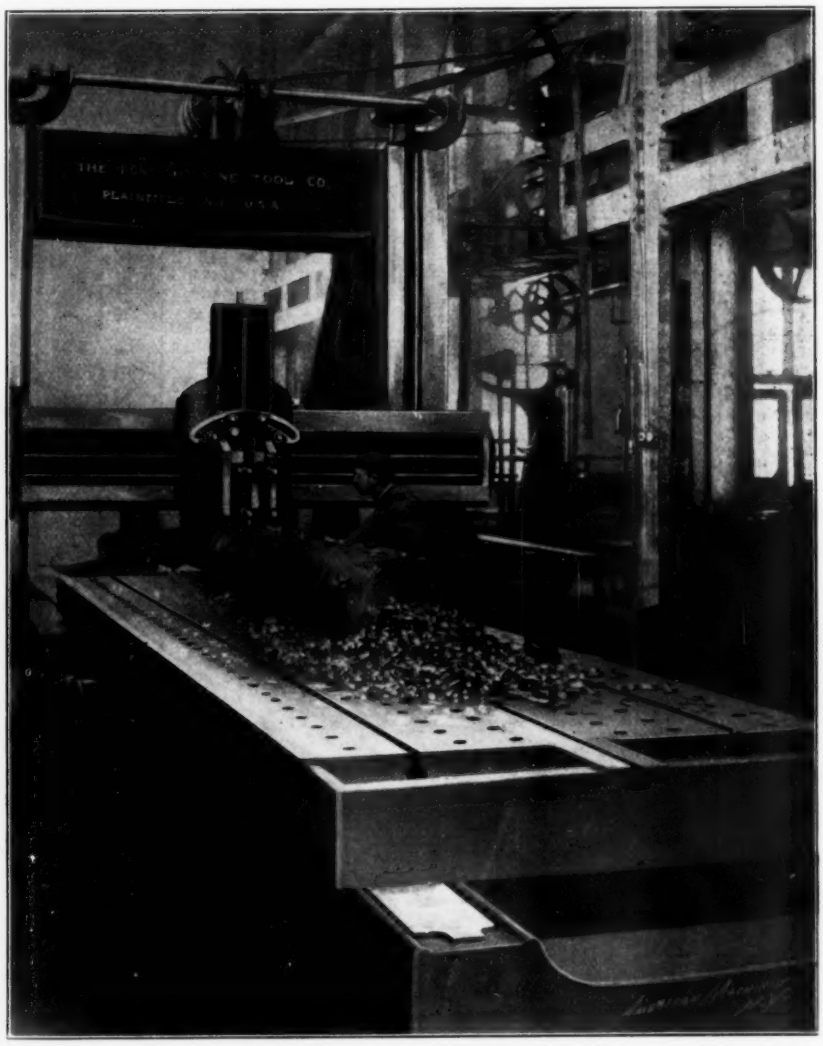


FIG. 29. PLANING STEEL AT 65 FEET PER MINUTE.

metal itself takes place. The internal pressure is frequently sufficient to cause the fluid portion of the metal to burst thru the "skin," formed on the upper surface of an open mold, where the metal has congealed by exposure to the air, forming pimples of eutectic alloy, and in some cases long filaments curling over in horn-like shapes are extruded.

On cutting a section thru an ingot or casting made in a metal mold, then polishing and etching, it will always be found much denser, more uniform in texture, and much more free from segregation than the same metal cast in a sand mold, while the specific gravity is also considerably higher. Such metal is not necessarily harder than when cast in sand, tho the "chips" are quite different in appearance. It may be likened to the difference in density and fineness of grain observed in a piece of pine wood that has been squeezed in a powerful hydraulic press, as compared with a piece of the same wood not compressed. Metallic alloys which have been subjected to this fluid compression show greatly increased tensile strength. These are facts not generally understood, all having important practical application in the metallurgical arts.

The Development and Use of High Speed Steel—Addendum.

Our issue No. 52 of Vol. 27 went to press before the photographs illustrating Mr. Gledhill's cases of high-speed planing were received from England and half-tones from these photographs were therefore necessarily omitted. They have now come to hand and are given herewith. Of them Fig. 29 illustrates the planing of 45-point carbon steel at a cutting speed of 65 and a return speed of 160 feet per minute. Fig. 30 shows a 14-foot planer operating on gray iron at 36 feet per minute, the depth of cut being 1¼ inches and the feed 7 per inch. The former machine is of the Pond make. Of the make of the latter we are not informed. Both are fitted with the Mitchell planer drive, which was illustrated at page 739, Vol. 27. The photographs are from the British Westinghouse Electric & Manufacturing Company's works.

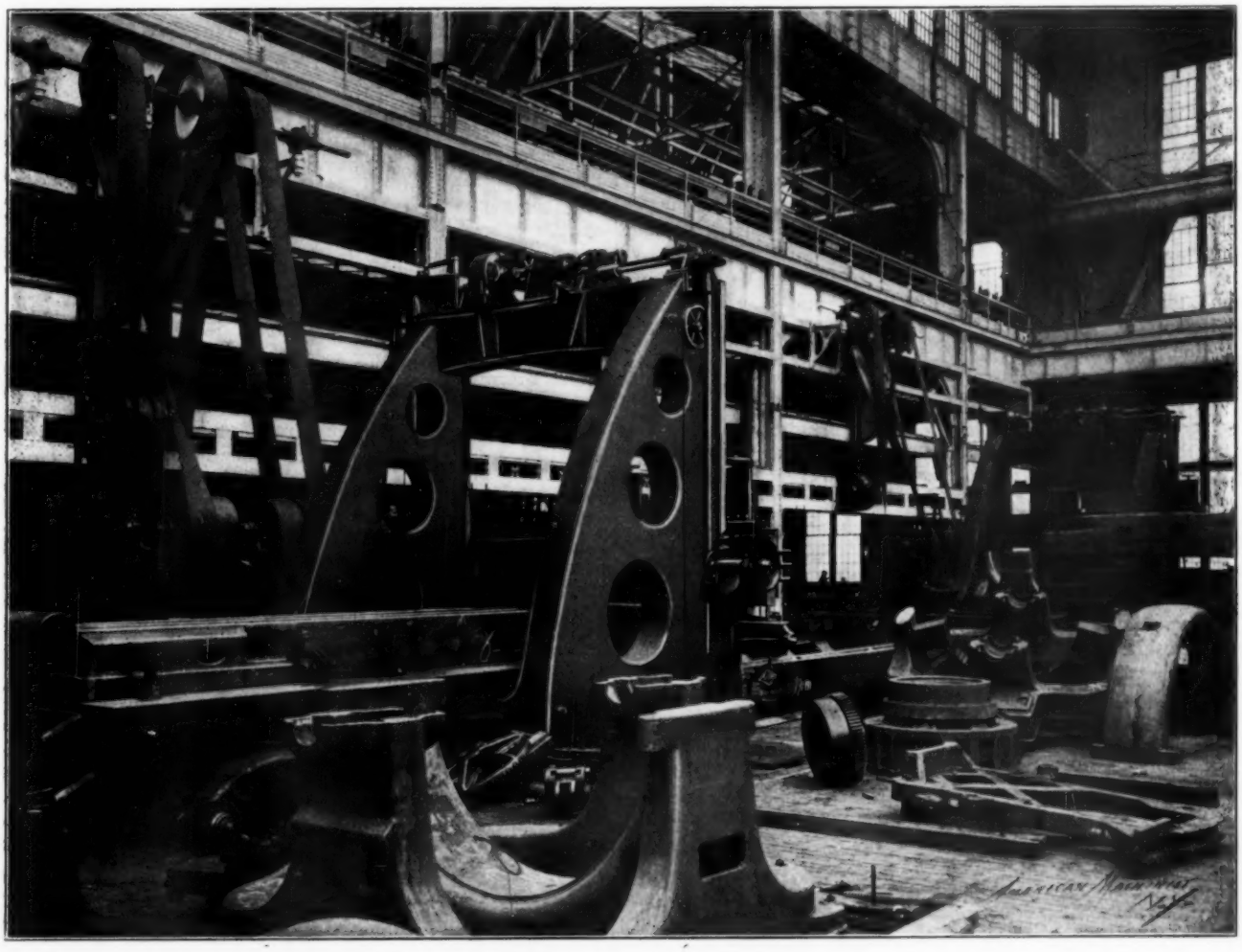


FIG. 30. PLANING GRAY IRON AT 36 FEET PER MINUTE.

A company has begun operations upon a cliff of feldspar on the shore of Lake Superior to convert it into abrasive material for use in the arts. It will be used largely for "sand" paper now generally made with glass.

Opportunities of the Apprenticeship Course.

The following was read before the Electric Club, of Pittsburg, by W. W. McFarland, acting vice-president of the Westinghouse Electric & Manufacturing Company. We understand it to refer exclusively to the apprenticeship course of the Westinghouse works.

I do not know whether you look upon it as such, but the fact is that the apprenticeship course is in reality a post-graduate course supplementing the theoretical training you obtained in the colleges and universities. You have acquired an acquaintance with the general principles governing engineering, and you now have the opportunity of acquiring intimate practical knowledge of the various details of the manufacture of electrical machinery. The course has been planned with a view to giving the broadest general acquaintance with this practical work, and not with the idea of making skilled handicraftsmen. The education, therefore, is that of the mind and not of the hand.

I cannot too strongly emphasize the opinion held by us older men that the apprenticeship course offers an unusual op-

portunity of which thorough advantage should be taken by the apprentices. It is not exaggerating at all to say that you have an opportunity which many older practising engineers, if it were practicable, would gladly pay a large sum to enjoy. There is no other way of getting an intimate practical acquaintance with machinery than by daily contact with it in the shop as it is built. I want to urge upon you, therefore, not to neglect this splendid opportunity, but utilize it to the fullest extent, even if you yourselves do not at present realize how great it is. Experience will prove to you later on that I am understating rather than overstating the opportunities which now lie before you.

It is to be remembered also that in a great technical business like ours it is getting to be more and more the case that all the higher positions must be filled by technically trained men. Even at the present time almost every one of our designing engineers is a graduate of the apprenticeship course; the same is true nearly to the same extent of the correspondence departments; and it is getting to be more and more true every day of the sales department. The engineers of the construction department are, of course, almost without exception, graduated apprentices. While none of the present executive officers are graduates of the apprenticeship course, they are all technical men. I am emphasizing this point to show you that your outlook upon the completion of the course is a bright one, and that, whatever your special aptitude, there is almost sure to be an opportunity for you to utilize it to advantage.

My personal acquaintance with a number of young men who have gone thru the apprenticeship course has led me to note that occasionally some are inclined to question the importance of what they consider the drudgery of certain sections of the works, and their anxiety seems to be to hasten thru all other sections into the dynamo testing department, where the work is comparatively clean and easy. Now, in my judgment, there can be no greater mistake than this. The work of the dynamo testing department is, of course, very important, but, after all, the same kind of information, tho not in so great a degree, can be acquired elsewhere. The knowledge and experience of the details of manufacture which are obtained by conscientious work in other sections of the factory cannot possibly be obtained in any other way.

In what I said a moment ago about openings for the future I did not speak of the works themselves, but I know it is the belief of some of our management, in which I concur, that the higher works positions offer a fine field for the technically educated man. There must be some among you to whom work of this kind will prove very attractive, so that if this is the case you should pay even more attention to processes as you go thru the shop than if your aim were to go into the selling department or some other branch. In other words, for the average man who does not expect to stay in the shop, what he is most anxious to learn is *what* is done in the manufacture of the machines rather than *how*, while the shop man is perhaps more interested in knowing the *how* than the *what*.

For more than one reason I urge you to keep your eyes open and observe carefully everything that is going on about you, including details of shop discipline, shop methods, etc. Whether you make your career with us or go elsewhere, the time will probably come when you will occupy an administrative position of some kind, and then the information you have gained of administrative methods will be of great value to you. The question of cost of manufacture as affected by the speed at which tools are driven, the new and improved tool steels that have been recently introduced, the relative advantages of driving by single motors and in groups, these and many other questions of shop methods are important to many officials of an organization other than those actually in the works. You now have the chance to make yourselves well acquainted with all these points, and you will make a great mistake if you allow this opportunity to go unimproved. Besides the actual information gained you will be training your powers of observation, and this is a most important matter. If time permitted I could tell you a number of very amusing stories respecting mistakes that are made from careless observation. My experience has shown me that young men are apt to pay much more attention to the details of working out the results of observation than to the observations themselves. Of course a little reflection shows that the most important thing of all is accuracy of observation, and you should take every opportunity to train your powers of observation so as to make them thoroughly efficient.

Another opportunity of the apprenticeship course which will never come to you again in life after you have passed to a higher position, is that of acquiring from intimate personal association with workmen their personal point of view. I think we must all realize that in questions of administration and discipline it is a tremendous advantage to the manager to be able to appreciate thoroughly the point of view taken by his men. Too often his only method of doing so is to attempt to put himself in their place and realize how they would look at things. In the apprenticeship course you work with them side by side, have a chance to become friends with them and to learn from them what they really think. We know from actual experience the objections put forward by labor agitators to piece work, the premium system and practically all methods of maximum production. I think most managers believe that this view is not shared by a majority of workmen, and indeed is distinctly opposed to the views of the best and most progressive men. There is also the question of the morale among men, as to such questions as loafing, limiting the amount of work to be done, etc. A manager finds it almost impossible to get the real feeling of the men on these points, but you from your daily association with them and observation of the way they actually behave, can acquire information which will be of the greatest possible value to you later on in life when you, in turn, come to occupy positions of responsibility.

It will not be necessary for all of you, but to some I would say, do not be discouraged by hard work and small pay at the beginning of your active life. It is, of course, a tremendous change from the relative freedom of college life to the daily routine of a manufacturing establishment, and it seems all the harder from the necessity for buckling down to hard work and long hours. Remember, however, that this part of the work is only for a few years, and it is worth while to go thru this training for the sake of the immense benefits which come from it. As respects the matter of pay, it is well to remember that in England, so far from young men who are in the shop to learn the details of the business receiving any compensation, they have to pay considerable sums, from $500 to $1,000 per annum, to have the privilege.

Just a word of caution and also encouragement with respect to some general matters. You have now begun your real life work, and will day by day be building up a reputation. It is most important, therefore, that you should form habits of conscientious attention to duty, zeal and industry. These are of the greatest possible importance to success in life, and obviously habits are only acquired by constant practise. Do not make the mistake of thinking that because the work which you are now doing puts you in a subordinate and unimportant position it makes no difference whether you do it cheerfully, zealously and intelligently. The habits which you form now will have a decisive effect upon your success in after life, and if you allow yourself to become indifferent and negligent, success will be impossible. I believe that it should be every young man's motto to do the work right at hand as well as he knows how. Do not allow yourself to dream of what you would do if you only had an opportunity to do important things, to the detriment of the simple and unimportant work which is assigned to you. It is safe to say that such dreamers never have the opportunity of doing the greater things which they imagine would arouse their interest.

Many persons not connected with the Westinghouse interests have commented upon the fine *esprit de corps* that obtains among the representatives of the various companies. I hope that you will all speed-

ily become imbued with this spirit. Doubtless one cause for this is the personality of the remarkable man who has founded these great industries. He is to-day, I believe, the only great captain of industry who is actively at the head of the works which he has built up. History shows that enthusiasm is much more easily aroused by a striking personality than by an abstract principle. I am sure, therefore, that you will all consider it of particular advantage to be enrolled among those who follow the leadership of Mr. Westinghouse. Of course it is impossible for any man who counts more than 20,000 people among his employees to be personally acquainted with even a small fraction of them, but it is nevertheless true that Mr. Westinghouse does take an interest in all that goes on and is on the lookout for specially able men. Some of you are undoubtedly destined in the future to occupy very high places in the company's organization and to become personally acquainted with him. It certainly would be a most laudable ambition for every one of you so to conduct himself that he might hope to be counted as one of the men who was regarded by our chief as destined to become one of the leaders.

American Ingenuity in Sulfur Production.

The following interesting item comes to us by way of Marseille, France. Robert P. Skinner, United States Consul-General at that port, contributes it to *Consular Reports:*

The entry of Louisiana sulfur into the world's market is an unmistakable triumph for American ingenuity and commercial courage, which has brought its own prompt reward. Our American sulfur deposits were discovered in Calcasieu Parish, La., thirty-five years ago, while petroleum boring was in progress. The sulfur found was practically useless, however, being buried under 400 feet of quicksand. The rock being porous and filled with water containing sulfureted hydrogen, the sinking of shafts was impossible by old methods. After millions of dollars had been spent in attempts to reach the sulfur, it was decided by Mr. Herman Frasch to extract it by the application of water, superheated under pressure to many degrees above boiling point. It is then forced by means of iron pipes into the sulfur rock. The sulfur, being insoluble in water and of greater specific gravity, falls to the bottom of the well or deposit, from which point it is raised to the surface by means of an air pump. On the surface it is allowed to congeal, and is then ready for shipment.

Recently an Otis electric elevator was shipped from Yonkers, N. Y., to the Grand Cathedral at Berlin for the exclusive use of the German Emperor. Its location will probably prevent his riding up and down *ad libitum*.

The Factoring Method of Extracting Roots.

BY ERNEST M'CULLOUGH.

Professor Robinson made a mistake when he called his method for extracting roots the "Approximation Method." The name prevents many from using it in ordinary work. I believe "The Factoring Method" is a better name and base it on the following definitions:

A square root is one of two equal factors.

A cube root is one of three equal factors, etc., etc.

The definition can be extended to any limit. While a handy table of factors is not essential, it is a wonderful help, and I enclose one calculated for twenty-five factors. The rule is simple and is the same for all roots.

Factors.	2d Power. The factor is the sq. root.	3d Power. The factor is the third root.	4th Power. The factor is the fourth root.	5th Power. The factor is the fifth root.
1	1	1	1	1
2	4	8	16	32
3	9	27	81	243
4	16	64	256	1,024
5	25	125	625	3,125
6	36	216	1,296	7,776
7	49	343	2,401	16,807
8	64	512	4,096	32,768
9	81	729	6,561	59,049
10	100	1,000	10,000	100,000
11	121	1,331	14,641	161,051
12	144	1,728	20,736	248,832
13	169	2,197	28,561	371,293
14	196	2,744	38,416	537,824
15	225	3,375	50,625	759,375
16	256	4,096	65,536	1,048,576
17	289	4,913	83,521	1,419,857
18	324	5,832	104,976	1,889,568
19	361	6,859	130,321	2,476,099
20	400	8,000	160,000	3,200,000
21	441	9,261	194,481	4,084,101
22	484	10,648	234,256	5,153,632
23	529	12,167	279,841	6,436,343
24	576	13,824	331,776	7,962,624
25	625	15,625	390,625	9,765,625

FACTOR TABLE FOR EXTRACTING ROOTS.

Rule for square root: Look in the table of second powers for the number nearest the given number of which the root is desired, and take the factor of that power. Divide the given number by that factor. Then divide the number by the half sum of the factor and quotient for a second approximation. Divide the number again by the half sum of the second approximation and the second quotient.

This process can be continued until the result is obtained to any required degree of exactness. Usually two divisions give the root to as great a number of places as is necessary. To men quick at figures and doing such work every day this is no quicker than the ordinary method for extracting square root. It has the merit however, of extreme simplicity and can never be forgotten. It should be taught in schools where children have not yet begun the study of algebra. In extracting higher roots, however, no method is so rapid.

Rule for the cube root: Look in the column of third powers for the number nearest the given number. Take out the factor. Divide the given number by that factor. Divide the quotient also by the factor. Take one-third the sum of the two divisors and the last quotient for a second divisor. Divide the given number by this second divisor and divide the quotient also by it. Take one-third the sum of twice the second divisor and the final quotient for a third divisor. It may not be necessary to divide the number a third time. This third divisor may be the cube root as close as needed. It is not necessary to give rules for the extraction of other roots. Any intelligent man can readily extract any root once the principle has been grasped. For the fourth root, the new divisor will be one-fourth the sum of the last quotient and three times the preceding divisor. For the fifth root, one-fifth the sum of the last quotient and four times the preceding divisor.

Each step is an approximation, hence the name. The closer the first factor is selected the fewer approximations there will be; that is the only reason for using the handy table. For the reason that rules for extracting roots are hard to remember and awkward to use, logarithms are generally used for everything beyond square root. The factoring method is an easy one and the rule not readily forgotten. It is handy when no tables of logarithms are at hand. The writer's apology for mentioning this method here is that every time he has had occasion to extract roots the method attracted attention and so far he has not found one who remembered having seen it. Nearly twenty men have copied the factoring table for future use. The method is given in Lübsen's work translated by H. H. Suplee, and in several works published in England.

[The reader will not fail to note that to the number of decimal places that the divisor and quotient agree they are correct—comparison of the two showing at once the degree of approximation to which the process has been carried.—Ed.]

Football and Locomotive Firing.

I take time here to make a statement that if one of your best football players in first-class training were placed on one of these big locomotives to fire it for a long trip, it would tax his physical powers a great deal more than his powers would be taxed by playing end position on a football team, and I might say that if he had, on a good hard winter's night, to shovel, in the course of five or six hours, about 15 tons of coal thru an 18-inch hole, and were it possible to see that 15 tons of coal piled up before him and he was told that he would have to put in that coal in five or six hours, I think he would quit his job before he tackled it.—*Robert Quayle to students of Iowa State College.*

Machine and Tool Industries of Chemnitz.

United States Consul J. F. Monaghan sends to *Consular Reports* an interesting account of the present condition of the machine building industries of Chemnitz, Germany. He says:

One often wonders how this city (Chemnitz), with its large machine-building works, has been so successful in competing upon the markets of the world, when a large proportion of the raw materials used comes from foreign countries, and a number of the large machine plants are located some miles from the railroads, so that everything must be hauled to and from the factories by means of trucks. The cheapness of labor seems a blessing here.

Tho a general improvement in local industrial conditions was manifest in the past year, the machine-building trade did not benefit particularly by the change. The annual reports submitted by the leading factories of Chemnitz to the local chamber of commerce show that almost invariably competition was very keen, orders hardly above the average, and prices so low as to leave but a small profit. In certain lines conditions were more favorable, especially in the spinning and thread machine building branch, which was well supplied with orders, and, toward the close of the year, was even crowded with work.

MACHINE TOOLS.

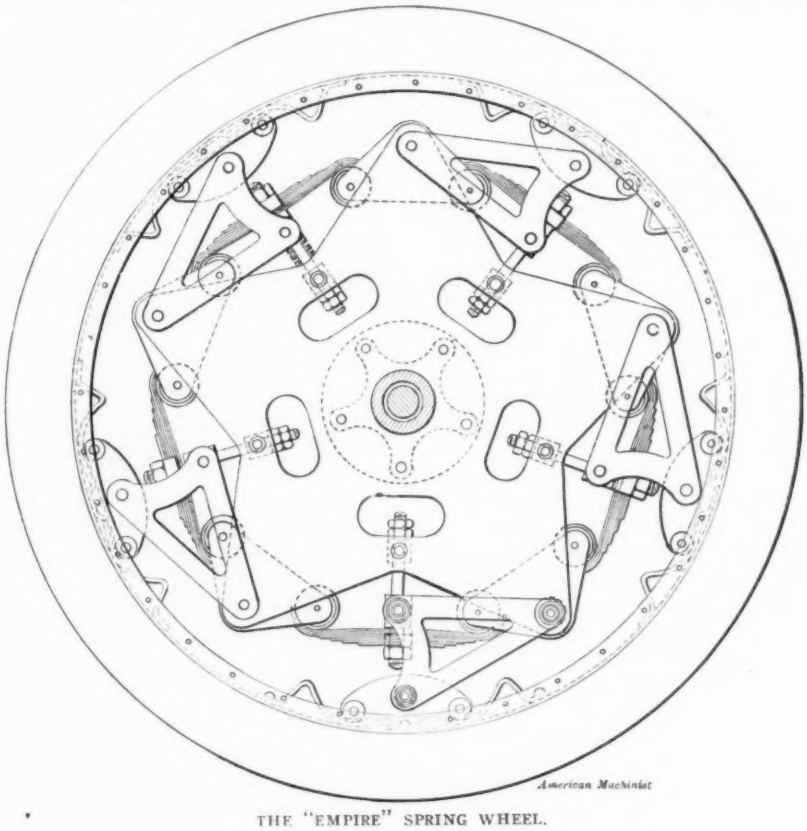
During the last six months of the year 1903 the machine tool industry continued to suffer from overproduction, a special effort having been made at this time to get rid of all accumulated stocks. The first six months of 1904 showed some improvement, thru the increase of foreign orders, but, on the whole, the situation is not satisfactory. Orders are still so slow in coming that most machine tool manufacturers have on their pay rolls but a limited number of hands. Complaints are also made in this industry that coal prices are held too high, and that large consumers are forced to import Bohemian coal in large quantities. The raw iron syndicate is also looked upon with suspicion, and has lost much credit thru its recent manipulation of prices.

Manufacturers of machine tools used directly in the building of machinery, and those used in keeping other machine tools in condition, have reported slow but steady improvement in their trade, due largely to a considerable increase in foreign orders. Inland orders are few and far between.

The knitting machine building trade is an important industry in Chemnitz, and was satisfactory during the past year. Knitting machine needles to the value of $10,000 were exported to the United States in three months, mostly by a single firm. Chemnitz also manufactures agricultural implements, bicycles and bicycle parts and electrical machinery.

The "Empire" Spring Wheel.

The ingenious wheel shown in the cut herewith, which we take from *Engineering*, London, is something more than a mechanical suggestion, as we have the assurance of the editor that he has been able to test the running of a car fitted with a set of these wheels over a variety of roads selected for their irregular surfaces and other trying conditions with quite gratifying results. The pneumatic tire is of course entirely dispensed with and a solid tire with flat tread takes its place. It will be seen that the wheel springs not only radially but also tangentially to equalize the irregular torque of the motor, in this latter respect showing an advantage over the pneumatic tire. The levers and other parts of the wheel are made of steel stampings for lightness and the mechanism is entirely enclosed by disks extending from the boss to the rim, thus forming a chamber for oil and excluding dust.



THE "EMPIRE" SPRING WHEEL.

The cut shows the wheel without the disk. Secured to the hub at each side are a pair of five-pointed star-shaped plates, connected together by a pin at each point of the star. Each pin carries a pair of triangular equalizing pieces between the plates, and a pair of triangular levers outside. Between the equalizing pieces are a pair of rollers, the rollers on adjacent triangles being connected by a series of plate-springs, the centers of which are attached to the star-plates by means of bolts passing freely thru distance pieces between the plates. Each bolt is also connected by pin joints to one pair of corners of the triangular levers already mentioned, the remaining pair of corners being jointed to the center of a pair of segments having rollers at the extremities which bear against the inner side of the rim of the wheel. It will be seen that any pressure on the rim of the wheel is transmitted from the plate-spring immediately opposite the point of application to the whole of the springs round the wheel by the agency of the equalizing pieces, and, further, that these springs are protected from any oblique strains by the triangular levers.

Inside the rim, on each side of the rollers of the segmental pieces are curved internal projections, so that any motion of the segments would cause the latter to approach the center of the wheel. This is resisted by the tension of the plate-springs, but will take place to a greater or less extent, depending on the irregularities of the power being transmitted thru the wheel, due to variations in the engine speed or in the road resistance.

The wheel is made by the Metropolitan Engineering Association, Limited, 4 Victoria street, London, E. C., and is the invention of Mr. A. S. Robinson.

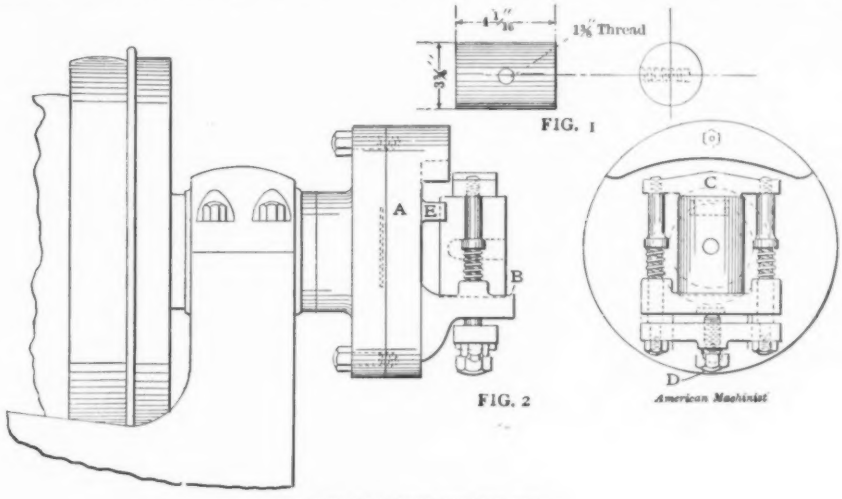
In a new power plant of the borough of Hammersmith, London, a novel system of thermal storage has been adopted. Four tanks of 50 tons capacity each have been placed which will be used to store heated water during the day, this hot water to be fed to the boilers at night when the greatest load is on, thus helping to equalize the work of the boiler furnaces.

Letters to the Editor.

A Plunger Bearing Pin Boring Rig.

The enclosed sketch shows a lathe fixture used in the boring and threading of plunger bearing pins, of the Laidlaw-Dunn-Gordon Company type. One of the pins to be threaded is shown in Fig. 1. It is essential that the 1⅜-inch threaded hole be exactly central with the sides of the pin and at right angles with the surface.

The counterbalanced fixture *A*, Fig. 2, is clamped to the lathe faceplate and held central by a boss which fits in a recess of the faceplate, as shown. *A* is bored out at *B* to a depth of 3-16 inch and slightly chamfered to receive the plunger pin. The clamp *C* is drawn down on the pin by means of screw *D* coming in contact with an inserted steel plate in *A*. The



A PLUNGER PIN BORING RIG.

two coil springs hold the clamp *C* up in position when releasing screw *D*.

Lug E is bored out to the radius of the pin and acts as a support for it.

G. V. HUBER.

Pneumatic Feed for Countersinking Ship Plates.

At the shops of the New York Shipbuilding Company, Camden, N. J., where they have the reputation of doing a great many things in *new ways*, I recently saw what was to me a new idea in quick feeds —*i. e.*, the piston of an air cylinder attached to the quill of a ship plate countersinking machine.

After the plates are punched, the holes which are to be countersunk are marked. The plate then goes to the countersinking machine. This machine is a sort of radial drill, the arm being made of two I-beams placed parallel to each other, so as to form a track for a carriage, which carries a drill press. This carriage has wheels both on top and underneath the I-beams, those underneath taking the thrust when the countersink is working.

There is usually no regular column for this machine, the I-beam arm being pivoted on a bracket attached to a post or wall. The carriage is for all adjustments to and from the center, and is pushed or pulled along the tracks by hand. The power is transmitted to the drill press from the pivot bracket by means of a splined shaft. The feed for the spindle is by means of a lever fulcrumed on a shaft which passes thru a gear engaging with the rack on the quill. The operator puts the plate to be countersunk upon blocking upon the table of the machine. This table is usually a large slab of iron 6 to 10 feet wide by 15 to 20 feet long. The table has a number of holes cored in its top surface so that stops may be put in, to prevent small pieces of plate being revolved by the countersink. Large plates require no stops. The blocking is usually about an inch thick and any old piece of wood is utilized, the object of the blocking being to prevent the countersink cutting the table.

The carriage is then moved along the arm and the arm swung on the pivot till the countersink is over the hole to be operated on. The operator then applies the weight of his body to the lever, forcing the countersink into the hole. There is nothing particular about the job, and as long as the holes are countersunk approximately the same depth they are good enough. Considerable exertion is necessary with this, the old style of countersinking.

The machine at the New York Shipbuilding Company is very much easier to run. It consists of a short, heavy, round column on a solid foundation. Pivoted on top of this column is a radial arm hung on ball bearings. The outer end of this arm carries another arm hung also on ball bearings. On the outer end of this last arm is mounted a drill press and the motor which drives it. The quill of this drill press is connected with the piston of an air cylinder. After the countersink has been located over a hole, the pressure of a finger on the air valve lever forces the countersink instantly down to its work, the release is just as easy and quick. The only physical exertion necessary is the moving of the countersink from hole to hole. Owing to the way the radial arms are hung on ball bearings, this is not great.

DIXIE.

Will Steam Supply Oxygen for Burning Oil ?

An article of more than ordinary interest appeared at page 1713, Vol. 27; for next to the food supply of the world the fuel that warms it and does its work is the most important. Anything that adds to our knowledge of the right use of it is of direct advantage to each one of us, and anything that increases the efficiency of its use is of even greater benefit than that which comes from a saving in the use of a power after it has been developed by the fuel, because it is more far-reaching in its possibilities. Among all of the fuels of the earth the liquid ones, the crude oils, are receiving the most attention at the present time. This is due to the fact that they are being found in sufficient quantities to be counted among the most important of the world's supplies of fuel.

In the article that I have referred to—"Steam vs. Air for Liquid Fuel and Oil Burners"—are some statements which, if they are correct, show that many things that have been believed up to this time are not true. While I cannot claim to be an expert in the use of oil as a fuel, there are some things in the article which are so very different from what I have believed that I would like to call attention to them, for if I am wrong and they are right we are close to the realizing of the dream of the man who supposed he was able to connect up a gas line and a water line to his stove and save all of the air for other purposes.

Taking the figures given, it would take 3.229 pounds of water to furnish enough oxygen to consume 1 pound of oil, and it would take 3.229 pounds of water to consume the hydrogen that is in the same 3.229 pounds of water. As hydrogen is said to have a very great affinity for the other elements, it might again unite with the oxygen even if by some means it should be separated from it. As the hydrogen in the oil is credited with doing so it is reasonable to suppose that free hydrogen will be as apt to.

And right here is another point that deserves a little consideration. If the hydrogen that is in that 3.229 pounds of water is completely consumed, it will furnish as much heat without using the pound of carbon as the carbon would furnish if the hydrogen in the water is allowed to go unused. Unless my knowledge of chemistry is entirely at fault, there is another fact that has also, seemingly, escaped attention. When oxygen and hydrogen unite to form water heat is generated, and when the process is reversed heat is required to accomplish it. In other words, if the 3.229 pounds of water are separated into the elements oxygen and hydrogen it will take all of the heat of the pound of oil to fur-

nish the heat that will be necessary. If this heat was used for such a purpose, then it would only remain for us, if we wanted heat, to reunite the oxygen and the hydrogen and thus get the heat which we could have gotten by burning the oil and using the heat for work instead of using it for the purpose of dissociating the water.

As it would be necessary to burn the oil before we could get the heat from it, we would have to supply air for that purpose, and after we had the oil burned we would not need the oxygen of the water for that purpose so we might as well use it for the free hydrogen on hand. Even if we supply a fresh pound of oil to burn with the oxygen of the water we have not gained anything, for we must also make use of that free hydrogen somehow or we have suffered a positive loss.

If my reasoning is right there would not be any gain even if we did manage to separate the hydrogen from the water, and I do not think that there is evidence to show that we do gain anything in practise.

WATER POURED ON A FIRE.

Some people may be disposed to bring forth as evidence the behavior of a small stream of water when thrown on a very fierce fire, or the process of making gas by passing steam thru an incandescent body of coke, but I would point out one great difference.

In the case of a fire there is a body of carbon in a highly heated state, a state in which it is very ready to enter into combination with oxygen. If it should take the oxygen from the water and so set the hydrogen free, it would pass along to a place where there was a supply of air and again enter into combination. In setting the hydrogen free the fire would have to give up heat which would be again set free at some other place. This might help the spread of the fire, but it would not increase the total amount of the heat.

In the case of the water gas the hydrogen meets with a supply of carbon that is free to combine with it and the liberated oxygen meets with a supply of carbon with which it can unite. We thus get a supply of gas composed of the carbon and the hydrogen, and also support the combustion without introducing so much nitrogen as would otherwise be the case.

In this process I do not think it is claimed that more heat is obtained from the gas than was in the original supply of carbon, but it is simply put into a more convenient form to use for certain purposes.

An examination of the analyses of various commercial gases will show that carbon is not found alone as a gas in any of them. It will always be in combination with some other element, and that element will be either oxygen or hydrogen. With these elements it forms a gas, and without them it is a solid.

There is no doubt that many chemical reactions are of such a nature that it cannot be positively stated just how they do proceed, and it might be altogether possible that fuel in being consumed in the presence of water in the form of steam might pass thru several different changes before it issued from the stack. As some of these changes took up heat and others gave out heat, it might make much difference in the effects produced, because of the intensity of the heat produced, and also because of the time and place where the reactions took place, and still the total quantity of heat produced not be changed.

So far as I have been able to learn, oil has never been burned with water as a supporter of combustion, and with the air totally omitted. Even in the article that I mentioned in the beginning it was thought that some air would find its way into the fire. It might be a matter of great surprise to some people to find what a lot of air can get in thru places which seem to be reasonably tight, when a little pressure is helping it. If my hand book is right a pressure of only one ounce per square inch will produce a velocity of more than 5,000 feet per minute.

UNITED STATES LIQUID FUEL BOARD.

Among the conclusions arrived at by the United States Naval "Liquid Fuel" Board I find a paragraph that is headed "Thermal Efficiency Not Increased by the Use of Steam." Here is the way that paragraph starts out: "There is a widespread misconception regarding the part that the steam which is used for atomizing purposes pays in effecting combustion. It is supposed by many that, after atomizing the oil, the steam is decomposed and that the hydrogen and carbon are again united, thus producing heat and adding to the heat value of the fuel. While it may be true that the presence of steam may change the character and sequence of the chemical reaction, and result in the production of a higher temperature at some part of the flame, such an advantage will be offset by lower temperatures elsewhere between the grate and the base of the stack. All steam that enters the furnace will, if combustion is complete, pass up the stack as steam, also carrying with it a certain quantity of waste heat. The amount of this waste heat will depend upon the amount of steam and its temperature at entrance to the furnace. The quantity of available heat is undoubtedly diminished by the introduction of steam."

In another place attention is called to the fact that the same results could not be obtained as to pounds of water evaporated on a day when the air was laden with moisture.

In the article before referred to, the statement was made: "It has been demonstrated that 1 pound of oil will evaporate at least 15 pounds of water." In the "Report" the best result that I have been able to find is 14.42 pounds of water per pound of oil, and that is away above the average. The average seemed to be between 11 and 12 pounds.

From the foregoing it must not be concluded that steam cannot be used to advantage in an oil burner. For certain kinds of work a steam burner is the best and the question is only as to the reason. I think it can all be explained on reasonable grounds. To burn oil in any quantity, as under a boiler, for instance, it is necessary that it be broken into a spray and the finer the spray the more readily the air, or oxygen, will get to it. Steam has more body than air, and on account of that it is reasonable to suppose that it would be more effective in knocking the oil into pieces than air. There is another thing that has to be done before the oil will burn—it has to be heated up to the igniting point, and it would seem that the large amount of heat that the steam carries would be useful for this purpose. As the amount of oil that can be burned is increased by heating the air when air is used as the spraying medium, it would seem to confirm this view of the matter. Air to contain as great a quantity of heat as steam at 80 pounds gage pressure would have to be heated "red hot," and under ordinary conditions both the pressure and the temperature of the air are much harder to produce than is the case with steam.

When it is understood that steam is a good thing and has its proper place in burning oil, but that it does not displace a bit of air in the final results, where those results are as good as they can be, invention is more apt to be in the proper direction.

SMOKE FROM OIL.

Just one word in regard to the matter of smoke. It is a common idea that smoke is always an indication of the lack of oxygen, but that is far from being the case. There are some forms of carbon that will not burn except in the presence of the most intense heat, and any attempt to rush a fire of crude oil too much will result in burning up the lighter combinations of carbon and setting the heavier ones free.

In looking at the analysis of a crude oil we see the quantity of each element, but we do not see what the forms of its combinations are. In the distillation of it we can see more of this, and here we see that it is a mixture of all sorts of combinations, from the light ones that are dangerous to handle, like gasoline and benzine, to carbon as found in the well-known electric light carbons, and which will not burn except in the most intense heat we can produce. From this it can be seen that the intensity of the fire is a factor, and if more than enough air necessary for combustion is allowed to get in its effect is to tend to produce smoke by lowering the temperature, and so it is with anything else that tends to keep the temperature below the burning point of any of the constituents of the oil being burned.

It has not been my object to more than

call attention to this subject, to the end that it may receive consideration. The article which I have here referred to was part of the proceedings of a society of engineers, and so was given such prominence that it deserves special attention. If it is right, the dream of the man who only needed to get started to set the river on fire may yet be realized.

W. O. PLATT.

Lapping and Testing Small Holes.

This letter relates to bushings that are not to be ground out but are worked as they come from the hardener.

There is one point in this work that is not given enough attention in small holes, say from 0.10 inch down as small as you can go, for the small ones are the easiest to be deceived with. Fig. 1 shows (exaggerated) what a seemingly straight hole would test up to in the gage, Fig. 2, to be described later. In lapping this hole it is very easy to say it is small in the center, and ease it there so the fit seems to be even. Think of a drill running in such a hole—and there are lots of them, and gages, too, with a hole like this.

Fig. 3 is a lap which gives good satisfaction. A taper pin that fits into a taper

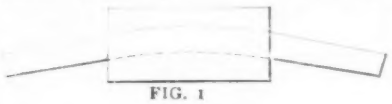


FIG. 1

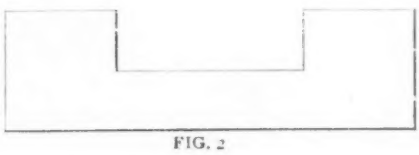


FIG. 2

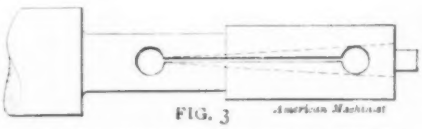


FIG. 3

LAP AND TEST GAGE FOR SMALL HOLES.

hole gives a good, solid adjustment for wear. There are two slits starting from a hole drilled thru the lap about ⅛ inch from the end, and extending to another hole which is at a sufficient distance to give an easy spring to the lap. I use two slits in laps, .1875 down to .080, using a fine fret-saw blade. Laps below .080 I ream out, so there is only a thin shell left that will expand without slitting when the arbor is tapped in. In holes too small for taper pins I use drawn brass wire, and to enlarge it use a hard steel V-block, the "V" being the right size to allow a flat piece to be placed on top of the wire and struck with a hammer; and I sometimes tin the wire if I can do it conveniently. Laps above .1875 can be used on the taper arbor held in the chuck. The metal for outside lapping should be gray iron for roughing and pure copper for finishing. Abrasives from good manufacturers run very close to what they are sold for. Brass or gray iron is full of dross which will leave marks on highly finished steel. In lapping small holes finish with drill rod tinned over and trued off.

The bell-mouthing of holes by lapping is caused by two things. A lap flooded keeps the ends of the hole always charged heavily; a lap run dry, as the tightly fitting portion comes out of the hole, expands (and it also does so when flooded), and, putting a greater pressure on a narrowing surface, produces a bell mouth. This works both ways; for a lap is large and must be compressed as it enters the hole, which helps increase the bell mouth. The nearer solid a lap is, the less trouble there is in using it, and Fig. 3 comes as near as you can make an adjustable lap for small sizes. Leave 1-16 inch on each end of the bushing for bell-mouthing, and when you grind it to length you will find that the hole is a little small at each end and will have to be touched out a little in most cases.

The length of the lapping part of the lap for a hole that is finished to length should be one-half of the length of the hole. In lapping a hole that is finished to length I use a lap that is about one and a half times the length of the bushing and charged by rolling between two hard, flat surfaces, then wiped almost dry by the hand. This lap shows me that the hole is not made hollowing with the narrow lap.

A simple test to find the error in a piece like Fig. 1 is to rough lap the hole then turn a pin in the lathe long enough to stick thru to test with an indicator. With very small holes take a piece of gray iron, Fig. 2, and plane a channel wide and deep enough to let the pin rest on the flat surface. If the pin lies flat on this surface before it is put in the bushing, it should while in the bushing with the ends sticking out about ½ inch.

Use half kerosene and lard oil for a lubricant, and diamond dust for small holes, or be satisfied with what carborundum will do, tho this will make you renew laps often.

SCOTTY.

Proving Multiplication.

At page 1373, Vol. 27, H. I. gives a method for proving multiplication. A method which I employ, and which is just as easy, if not easier, is as follows: Add the figures in the multiplicand, and as soon as the sum exceeds 9 subtract the 9 and add the remainder, if any, to the following figure; and so on, taking care to subtract the 9 every time that the sum exceeds that figure, until all the figures are added, and if there is any sum not exceeding 9 when all the figures are used, put that figure down. Do the same with the multiplier. Now multiply the two figures thus left, and from the product subtract the nines, if any, and mark the result. Subtract the nines from the product of the original multiplication, and if correct the remainder should be like that of the operation in testing. To better illustrate the method I will follow the example given by H. I.:

$$134.95 \times 3.1416 = 423.958920$$

$$1 + 3 + 4 + 5 = 13;\ 13 - 9 = 4$$

$$3 + 1 + 4 + 1 = 9;\ 9 - 9 = 0$$

Therefore we take the 6 alone.

$$4 \times 6 = 24$$

In 24 there are two nines with a remainder of 6. Now

$$4 + 2 + 3 = 9;\ 9 - 9 = 0;\ 5 + 8 = 13;$$

$$13 - 9 = 4;\ 4 + 2 = 6,$$

which is equal to 4×6 after the nines have been subtracted. You will see that in adding the figures the nines that may happen to be there are left out; it is no use to include them, as they have to be subtracted.

It may happen with this method that a mistake, if any, made in the multiplication may be such that the test would show the multiplication to be correct, but the probability is so small that in the twenty

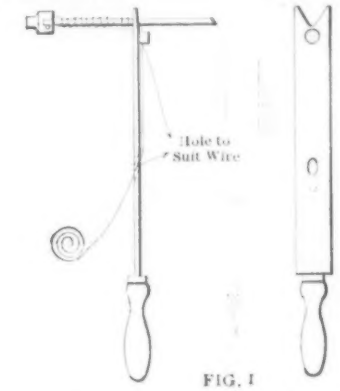


FIG. 1

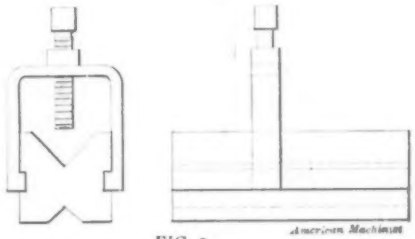


FIG. 2

A SPRING WINDER AND A BLOCK.

years that I have used this method it failed only once; and then the same thing might happen by H. I.'s method.

EDWARD SERRA.

A Spring Winder and a V-Block.

Having noticed several spring-winding devices in the AMERICAN MACHINIST set me to thinking that perhaps one that I find very useful would help someone else. Sketch No. 1 will explain itself, I think; also the V-block, No. 2, that I made for myself. Now, these may not be new to a great many, but are good ones. I am at present employed in a general repair shop and special machinery manufactory. The proprietor is a young man, and seems to have an unlimited supply of ideas for special wire-working machinery. The foreman is a brother of the proprietor, and up to a few years ago was a coal miner.

For bullheadedness he certainly takes the palm. He will not take any suggestion from anybody and will do a thing wrong to have his own way. He also has some names of his own for things of the shop. A rack he calls a *cog shaft.* If he wants a keyway cut, it is: "Say, Ed" (or Bert, or whomsoever he happens to see first), "jist you take this here shaft and cut a *gash* in it for me," or "Cut a *slice* off this here castin'," etc. The boys have a great deal of fun at his expense. We are now making a wire fence machine, and he made what he called a set of "life-size drawin's." We need an interpreter most of the time. L. E. T.

Slot Index Die for Armature Punchings.

The accompanying sketch will serve to show a die, known as a slot index die, used for punching the slots in armature disks. This die is for punching the slots only, two operations being performed on the disk before coming to this die, namely, the punching of the hole and keyway and the blanking to size (outside diameter), a large circular die being used for this. These operations are simple and no description or explanation is considered necessary.

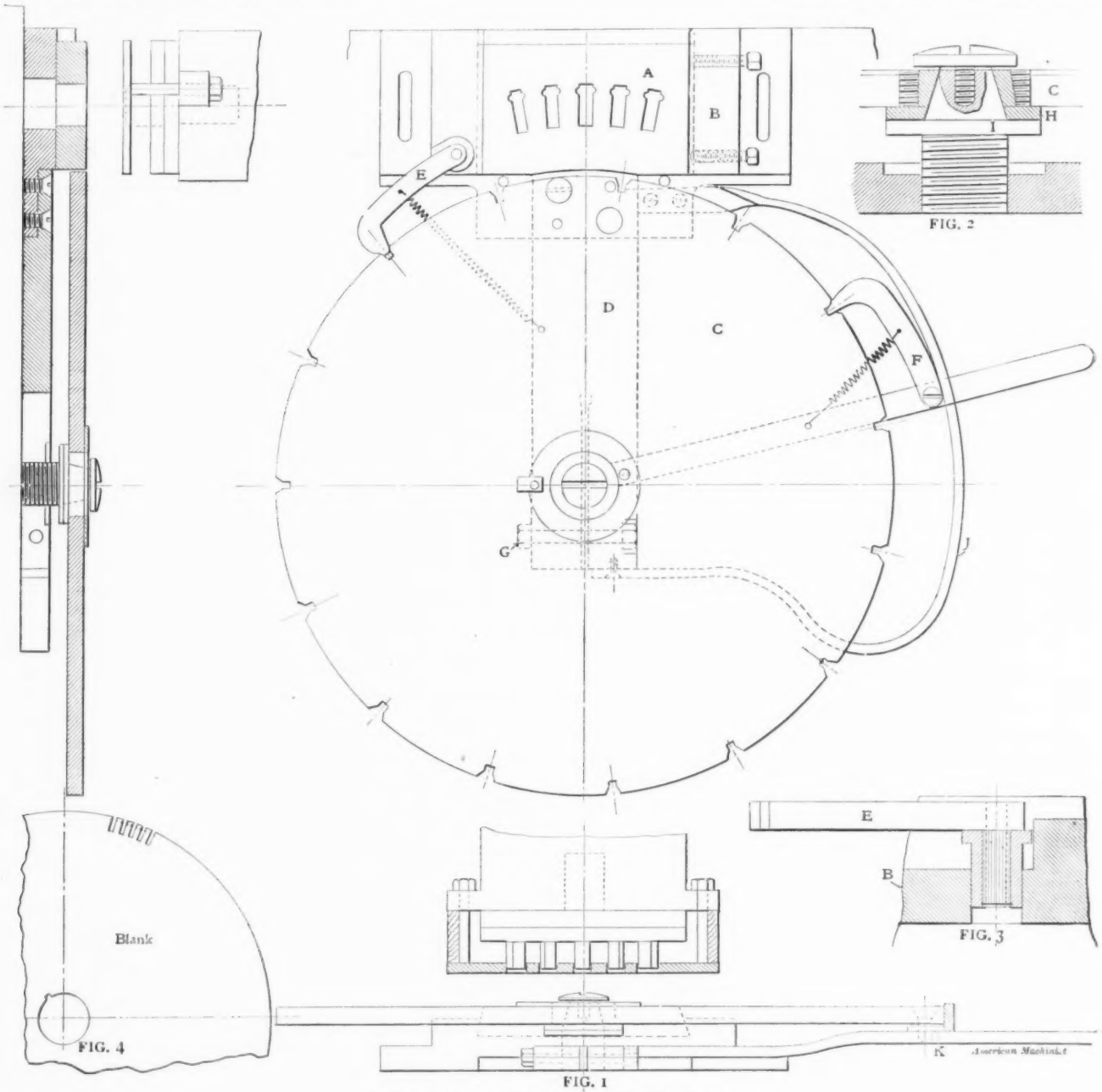


FIG. 1

SLOT INDEX DIE FOR ARMATURE PUNCHING

In Fig. 1, *A* is the die block made of tool steel. The five slots are drilled and filed to size; a ½-degree taper being given to let the scrap fall thru freely. The die is hardened and the top and bottom are ground true. *B* is the gray-iron die-shoe, planed and fitted as per sketch. *C*, the index plate, is of mild steel turned true and the hole threaded to take in the phosphor bronze bushing *H* shown in Fig. 2. This plate is also notched as shown. The disk in this case is to have 75 slots; the die having 5 slots, therefore the plate should have 1 notch for every 5 slots; or, in other words, the plate has 15 notches. The center of the plate is turned to fit the hole in the disk, a key being fitted into it to fit the keyway in the disk. *D*, the index arm, is of mild steel and is fastened by screws and doweled to the gray-iron shoe *B*. This arm is also bored and threaded to receive the center stud *I*, as shown in Fig. 2. It also has a saw slit about one-third of the distance from the end and a clamp bolt *G* thru the end for clamping stud *I*. The lever *E*, Fig. 1, acts as a stop, the spring tension being quite sufficient to hold the lever in the notch as shown, in this manner holding the index plate in position. *F* is the operating lever and *J* the supporting rail for it.

The operation is performed thus: The

disk or blank Fig. 4 is placed in position on index plate *C*, Fig. 1, and the first five slots are punched. Then a steady pull on the lever *F* will release the stop lever *E* and the plate will turn until the lever *E* drops into the next notch, when the next lot of five slots are punched. This operation is repeated until the circle of slots is completed.

It will be noticed in this construction that provision has been made for adjusting the different parts. The cutting edges of the die will wear, thereby necessitating grinding off the face of the die. This consequently will bring the die lower than the index plate *C*, also lower than the levers *E* and *F*. To adjust the index plate *C*, release clamp bolt *G*, Fig. 1, and turn stud *I*, Fig. 2, until the plate *C* is in the same plane as the face of the die, then again fasten clamp bolt *G*. The lever *E* is lowered by driving the bushing *L* into the gray-iron shoe *B*, shown in Fig. 3, until in proper position in relation to the index plate. The lever *F* is taken off and a sufficient amount is taken off of piece *K* to bring *F* in proper position.

These dies are made in various sizes up to 20 inches radius and are giving satisfaction. They are here shown as made at a large up-to-date electrical concern in England. WM. F. HOFFMANN.

Different Conditions Determining Tool Steel Practise.

At page 1708, Vol. 27, there is a letter entitled "A Critic of High-Speed Steel." Now, I freely admit that my experience with high-speed steel is very limited, but it is not because of prejudice that we do not use it. It is my opinion that in our case the saving over our present practise would not offset the expense. Some of Mr. Cameron's statements in the letter referred to I take exception to. He says, "In most well-conducted shops forgings and castings will come as close as possible to size," or words to that effect; also that "almost any fellow can throw on feed enough to take a big, heavy chip." Now, we make an article which it is not practical to make of a forging. That is, it is not commercially practical to do so. There is a 5/8-inch hole thru it, and it is necessary to make it of 1 5-16 inch steel, altho the principal finished size is 1 inch. We find it cheaper to have these pieces roughed out for us from the bar on a "flat turret lathe," as it is more convenient to handle them this way, and if one is spoiled in drilling (which is the first operation), there is not the added cost of a forging for junk. Also if in turning (rough) a fellow puts on feed enough to take a big, heavy chip, he will very likely have all his time to charge to it when he has done it. It is better with this job to have something else for him to do and make watching the lathe a side issue; or, if not possible to do this, to have a cheap man or a boy to watch the lathe and have the man do something that requires his skill.

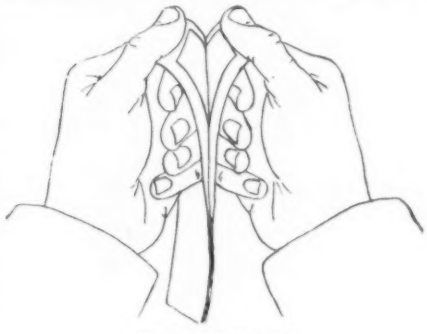
Of course, we all know that what is good practise on one job or in one shop would not be so in another place. I know of at least one shop making taps and dies where they do not use, and never have used, anything but bar steel to make their taps, they claiming that they can get better results by turning them out of the bar; and their taps are all right, too, and the business is prosperous.

Now about a man with a wheelbarrow removing the chips from a machine using high-speed steel: I don't know that all of the steels make the same kind of chips. My experience has been with "Novo," and the chips have been in such shapes that you could not get them into a wheelbarrow. They were like loose bundles of wire. I do not think a fellow should get an idea that he cannot use anything but one kind of steel. There are times and places where it is to the advantage of the work in hand for a man to be free to use some other tool or method, and, as Mr. Cameron says, no matter what steel is used, it is the man behind it that counts.

D. W. ROGERS.

Splitting Paper.

The following method of splitting paper will be found very efficient, and can be



SPLITTING PAPER.

performed at a very small expense. The materials required comprise two pieces of cotton cloth one or two inches larger each way than the paper to be split, some flour paste and a dish of warm water. Commence by covering one side of the paper with a thin coating of paste. After dampening a piece of cloth, place same on paste side of paper, smoothing out and removing any air that may be under the cloth. Treat the opposite side of the paper in the same manner and allow the mass to become thoroughly dry before splitting, which is done by separating any two corresponding corners, as in the illustration, and gently pulling apart. If a good job of applying the paste has been performed the operator will be pleased to see paper adhering to each piece of cloth. Allow the same to soak in water, and take great care in handling the paper before it is dry. WM. C. TERRY.

[This is sometimes useful when drawings or engravings are printed on both sides of a sheet and it is desired to file them separately.—Ed.]

What Should He Have Paid?

A man bought a gas engine that was rated by the seller as a 75 horse-power engine. He represented that it could be run for $20 per month, running twenty-four hours per day, and carrying the load the buyer had for it. This load the buyer was led to believe was very near the full capacity of the engine.

The price was to be $1,600, and the strong inducement to buy was the alleged economy, as it was to replace a steam engine and boiler.

The buyer was not posted on gas engines, but he figured out a good profit, *if the engine would do as represented.* Of this he had such doubts as to lead him to hesitate; but he finally closed the deal under a written guarantee that contained a proviso that if the gas consumption was above $20 per month the price of the engine was to be reduced in proportion as the cost of the gas increased. The gas used was natural gas of a heat value of about 1,100 B. T. U., and cost 18 cents per 1,000.

After the engine had been duly installed and was working, it was found that the gas bill went up to $43 per month, and the question of the price to be paid under the guarantee became a very live one, and one which there seemed to be a very wide difference of opinion on.

After figuring all around the question, and having a number of others figure for him, the buyer of the engine sent in a bill of $96 to the maker of the engine. This he thought would be a proper settlement under the guarantee; he, of course, to also keep the engine, on which he had not made any payment.

He admits that this conclusion was reached by taking the construction and figures that were most favorable to himself, and was rather more favorable than he really expected the final settlement would be, but he had come to the conclusion that the salesman had sold him an engine much smaller than stated and had guessed that even it was larger than really needed, and so had taken chances on the gas, feeling that he could afford to have the price cut down liberally and still make money. Incidentally he discovered that another party some hundreds of miles away had bought one of the same size for $1,250.

As a compromise, and to save litigation, he finally paid $500 for the engine, but says he has never been able to satisfy himself as to how much he should have paid to have carried out the terms of the guarantee.

Perhaps someone can give him some light on the subject. I can only suggest the proportion $43 : 20 :: 1,600 : x$; but this does not altogether satisfy me, as I can clearly see that if the gas bill went high enough the engine would be a loss as a gift, and in that case x should be a negative quantity, which it would never become in the way I state it.

It may be thought that this was a very loose sort of guarantee, but when trouble arises many guarantees thought all right when drawn are found to be loose.

WILBER.

Plain Figures.

That figure 9! How many times has it been abused? I saw in the AMERICAN MACHINIST that it was abused again a few weeks ago, and have heard of firms not using a 9 on a drawing whenever it could conveniently be omitted. The Germans can give us a few lessons in the shapes of figures. Take for example their written figure 1. Made as they make it in Fig. 1 it could not possibly be mistaken as anything else by itself or when accompanied by any other figure. If accompanied by 6, 8 or 9 it would show which was the right way up, making up for the deficiencies of the figures named; but with the English figures 16 may be read as 91, 18 as 81, and 19 as 61. In looking at the German figures (Fig. 2), it will be seen that there is only one doubtful figure—8. By "doubtful" I mean that the figure 8 is the only figure that when turned upside down can be read as a figure. At first

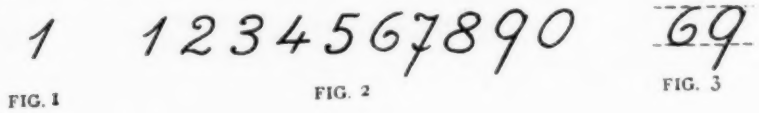


FIG. 1 FIG. 2 FIG. 3

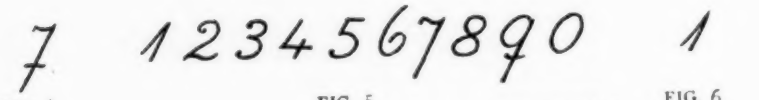


FIG. 4 FIG. 5 FIG. 6

PLAIN FIGURES.

sight one might think that 6 and 9 also belong to that class, but it is not so. The German 9 has a very long tail, while the 6 is only the same size as the other figures including the tail, as shown in Fig. 3. As regards the other figures, they are the same as the English ones, except the 1 and the 7; the 1 having a stroke at the beginning and the 7 a dash thru the tail.

It is peculiar that the first figures children are taught to make include the small stroke before 1; but it is left off when they are a few years older, whereas the Germans carry it thru. When we look at the English figures it will be seen that four figures are doubtful, namely, 1, 6, 8 and 9. Then why cannot they be revised, even if we have to borrow from the Germans? I think that Fig. 5 gives a set of figures which, while not differing radically from the originals, have only one doubtful figure, 8, among them. One doubtful figure, like 8, makes no difference, as when it is upside down it still reads 8, and when with any other figures it is seen which is the right way up by those figures. The only alterations in Fig. 5 are in the 1 and 9, the 1 having a stroke at the commencement, which the Germans more often than not make as long as the figure, as in Fig. 6, therefore making it a part of the figure, and not as a commencement stroke which can be left off, and the 9 with a dash thru the tail to distinguish it from 6.

CHEDDIE.

Steam for Oil Burners.

At page 1713, Vol. 27, you publish an extract from a paper, by Geo. G. Bennett, read before the Ohio Society of Mechanical, Electrical and Steam Engineers on the subject of "Steam vs. Air for Liquid Fuel and Oil Burners." Mr. Bennett claims to have demonstrated by experiment, to his own satisfaction, that the oxygen contained in the steam used to atomize the oil is sufficient to support combustion.

I failed to find in the article published any account of this experiment and am curious to know how he arrived at the satisfactory results. He refers to the recent tests and report of the Liquid Fuel Board of the United States Navy, which, by the way, is the most complete record of the application of oil fuel to marine boilers that has ever been published. [See abstract of the results of this trial at page 1417, Vol. 27.—Ed. A. M.]

In comparing test No. 3 under natural draft with No. 8 under forced draft, Mr. Bennett fails to bring out the whole story, and I think does not comprehend the different conditions under which these tests were made.

Assume for comparison that the boiler used in both tests was rated at 10 square feet heating surface per horse-power, or 3.4 pounds of water evaporated from and at 212 degrees per hour per square foot of heating surface; then, as the report gives 2,130 square feet of heating surface in the boiler, we will see that No. 3 test was run at about one-third over nominal capacity while No. 8 was at about four and one-half times nominal.

All marine boilers are subject to forcing, and the water evaporated per square foot of heating surface and fuel burned per square foot of grate surface is much higher than in the ordinary land practise. The size of the furnace and the shape of the setting are governed by the space allotted by the naval constructors, so that very little time is given, in the water-tube torpedo boat boiler, for the gases to perfect combustion between the point of ignition and the stack.

In test No. 8 with the conditions as stated no steam burner would have reduced the smoke. It may be well to add that altho Mr. Bennett states that the steam used in a burner is but a small proportion of the total boiler capacity ("2 per cent.," he states, "is high") I have found by several years' experience that 5 per cent. is about as low as any steam burner will run in continuous service, and some of the "slot type" of burners use 10 per cent. This loss of steam, or of fresh water, prevents the use of steam burners for marine service, unless the trips between fresh water supply are short, and it would not be practicable to install evaporators large enough to make up this loss.

Test No.	Evap. from and at 212° per lb. oil.	Evap. per hour lbs. water.	Evap. per sq. ft. heating surface.	Cu. ft. air per 1 lb. oil.	Smoke.
3	14.43	9750	5.18	62	Hardly visible.
8	10.77	31001	16.27	36	Heavy.

Mr. Bennett condemns the whole air burner system as impracticable without giving any proof to substantiate his claim and without showing much general knowledge of the subject. He states that a "combustible so volatile and inflammable as oil does not require as much air as wood or coal." Anyone who knows the simple laws of combustion also knows that a pound of combustible whether in the form of wood, coal, or oil requires just so much air to complete its combustion.

In the application of oil to land boilers where the loss of fresh water need not be considered, the steam burner is certainly the simplest form. The degree of atomization depends upon the velocity of the atomizing agent, and steam at from 80 to 100 pounds pressure thru the burner nozzle will do this work well. Theoretically, it may be noted that its effiicency in atomizing was found by the Liquid Fuel Board to be only about 1 per cent., but this may be disregarded in the case of a land boiler in view of the simplicity of its application. The question of gain by the separation of the steam used for atomizing into oxygen and hydrogen, and using these to aid in combustion is a very doubtful one. The heat to cause this disassociation must come from the fuel consumed, and if the chemical problem is carried out it will present the old picture of a man lifting himself over a fence by pulling on his boot straps. I think that Mr. Bennett will find that the "more or less atmospheric air" which he says "will find its way into the furnace" will do more to perfect the combustion than the steam going in thru the burner.

The furnace construction which he mentions is very primitive, and I would advise him to see a boiler set to burn oil.

The modern setting is simple and can readily be changed to burn coal, but it consists of something more than covering the grate bars with fire brick and ashes. When oil is atomized it assumes a globular form, and when one considers the pressure that oil in a bearing will stand, some idea can be formed of the difficulty the air has in reaching the interior of these minute globules and thoroughly uniting with the combustible, therefore "getting air in the right place at the right time" is quite a problem, as Mr. Bennett rightly states.

In forge burners using air for atomizing at from 40 to 80 pounds pressure and from 2 to 5 gallons of oil per hour, an intense heat is generated close to the burner, owing to the atomizing agent perfecting combustion with the assistance of the air drawn in at the burner port by the action of the air jet. When this application is increased to the size required by boiler practise the heat is concentrated in the firebox or furnace and is not properly distributed. With steam the combustion is slower and the distribution is better when the ordinary openings for air thru the ash pit are used.

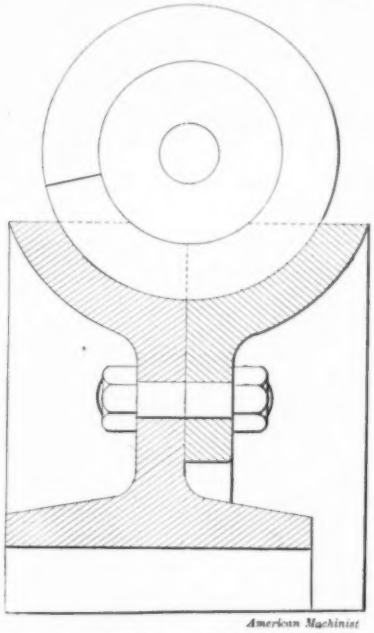
With the air at from 1 to 5 pounds pressure from a positive blower, when the boiler is run at about its rated capacity, a slight reduction in the amount of oil used will be noted over that with steam atomization, due no doubt to the heat necessary to maintain the temperature of the steam in the furnace. When a large quantity of oil, say 25 to 30 gallons per hour, is used, the low-pressure air does not give the velocity necessary for good atomization. Mr. Bennett's figures to prove his theory are rather interesting. Taking them as they stand, he states that in 1 pound of steam there is by weight 0.889 pound of oxygen and 0.111 pound of hydrogen, and 1 pound of hydrogen requires 8 pounds of oxygen for its combustion, which is contained in $8 \div 0.111 = 72$ pounds of steam. Now, with the proportion given—0.889 pound of oxygen in 1 pound of steam—I would hope to get 8 pounds of oxygen out of 9 pounds of steam, unless figures are guilty of gross prevarication. A little later he gets his balance on the other side by stating that in the average crude oil there is 12 per cent. of hydrogen, and as 1 pound of hydrogen requires 8 pounds of oxygen for combustion, therefore $8 \times 0.12 = .96$ pound of steam. Now, unfortunately for the calculation, steam is not *all* oxygen, but, as stated above, has 0.889 pound of the latter in 1 pound of the former; consequently, to find .96 pound of oxygen I would expect to use 1.08 pounds of steam.

These, however, are minor details compared with others in Mr. Bennett's calculations, and his figures are like signals in a football game—liable to get mixed.

Oil is an ideal fuel, and I wish it were used more generally, providing the supply would equal the demand. Each plant which adopts oil has to be equipped for its individual requirements, and steam or air may be used for atomizing as may best meet the conditions. I spent some years at this work and am still learning, so that is why I appreciate the report of the Liquid Fuel Board. There is a question I would like Mr. Bennett to answer, and that is, What are the names of the battleships and cruisers around New York using oil for fuel. W. D. HOFFMAN.

A Worm Gear Suggestion.

At page 1670, Vol. 27, Mr. Fred Ginkel describes a method of casting a worm-wheel to get a good wearing surface. It gives an impression of one-sidedness and looks as if there would be side thrust. If the room taken up and the extra expense would not be too much, I would suggest



A WORM GEAR SUGGESTION.

adding the other half of the rim, as this could be cast and bolted on as per sketch. This would give additional wearing surface. ERNEST J. LEES.

Apprenticeship.

The illustration and description of the apprentices' shop at the Nuremburg plant at page 1453, Vol. 27, and the letters of Messrs. Fairfield, page 1508; X. Y. Z., page 1511, and W. B. Hunt, page 1513, are interesting as bearing on different aspects of the problem of training youths for the various engineering avocations. Mr. Fairfield draws attention to the positive benefits derived from attendance at evening drawing, etc., classes, and from my own knowledge I can emphasize his statement that *persevering* students at classes carried on under the auspices of the various authorities he names have, practically, invariably advanced their prospects by their efforts, and that incidental failings in the management of what are often in the nature of fraternally helpful classes ought not to preclude due recognition of the good work they generally accomplish. X. Y. Z.'s description of British apprenticeship would apply to probably a majority of the shops here even yet, as, generally speaking, a number of years of regular work at one branch of the trade carries more weight in the selection of workmen by employers than a more varied tho less thorough experience. An appreciable number of youths, however, develop into fairly all-round mechanics, capable of taking up any branch in reason. I fancy the "all-round" American system is even now changing in the direction of British practise. To those apprentices whose leanings are toward original work, or managerial functions, as all-round a training as can be obtained, even if a trifle superficial, is desirable, as specialization can be taken up at a later point. The German instance shows that the employer recognizes the right of the apprentice to definite teaching, and not simply to employment directly beneficial to the employer. Mr. Hunt tackles the question in an eminently broad spirit. Two of the best items he mentions are, the boys being sent out with erecting gangs, and the visiting of other shops. His methods are deserving of the sincerest compliment—imitation. Unless it is seriously intended to allow a youth reasonable opportunity of acquiring such measure of craft skill as will place him, on the conclusion of his apprenticeship, in a position rendering him capable of exercising some amount of choice as to the shop he will work in, it would be more kind and business-like to intimate, on his engagement, that he is only employed as a convenience, and must take his own risks as to whether he will be able to pick up a working knowledge of a trade.

A MANCHESTER PLAN.

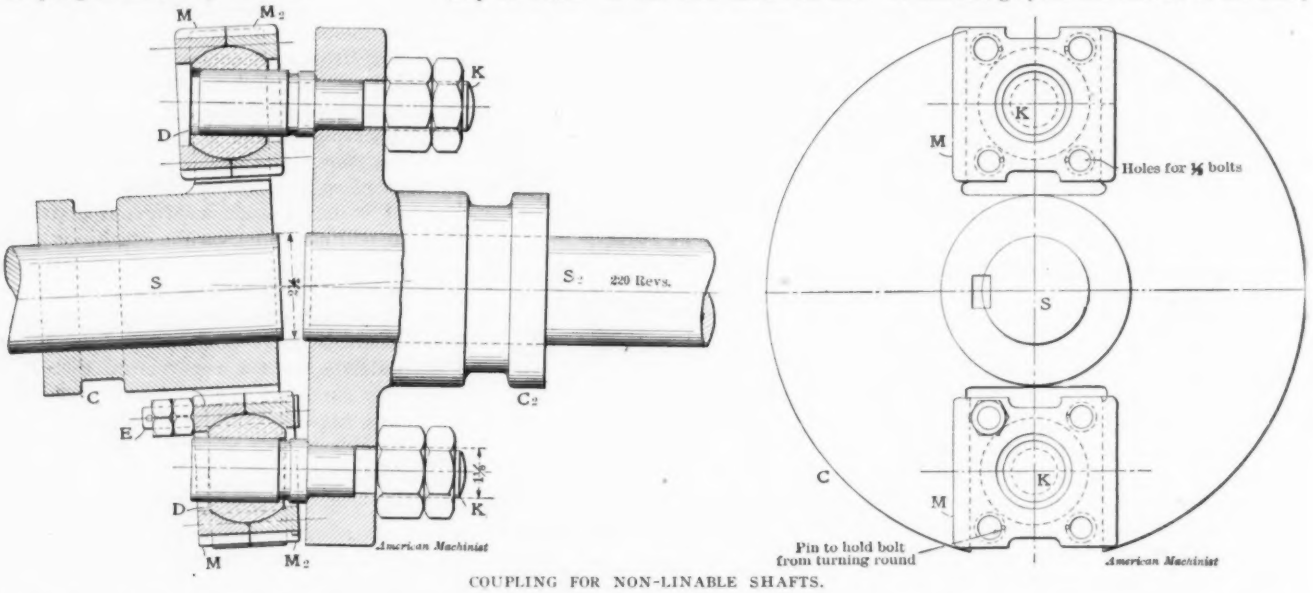
A recent departure in methods of technical instruction on the part of the Manchester School of Technology may be worth noting in this connection. Youths already employed in engineering works, who pass a preliminary examination, are put thru a mechanical engineering course on Monday in each week. The course occupies about eight months in each year. The class fee is $7.50 for each year's course. The employer allows the student the day off his usual work, and the fee is paid by the student or as may mutually be arranged. This plan allows the home lessons to be prepared in the evenings, ready for the next Monday's class, and obviates much loss of time going to and from classes as in the ordinary method, which is also needlessly exacting in its demands on the students' physique as compared with the plan described. The pupils must be eighteen years of age when entered, and the result of the first year's working is regarded as quite satisfactory. Considering the subject of apprenticeship and the class of mechanics produced by various methods, I am of opinion that

shortsightedness and lack of practical imaginativeness are not confined to any one section of an industrial organization or staff, and I have pretty well come to the conclusion that whatever class of workmen are found in a shop after the lapse of a few years from its initiation, they are exactly the class the shop deserves to have. JAMES VOSE.

Manchester, England.

Combination Clutch Coupling for Nonlinable Shaft.

Some millwright whose ideas on the subject of putting up shafting were, to say the least, peculiar, necessitated a coupling of the nature shown to be designed. The 2½-inch shaft *S 2* running at 220 revolutions was the one erected by the aforesaid millwright and acted as the driver. For various reasons the new line of shafting *S* was required to be put out of gear periodically, and it was therefore decided to combine the functions of clutch and coupling as shown by the cut.



COUPLING FOR NON-LINABLE SHAFTS.

The flanges *C* and *C 2* are spline mounted on their respective shafts, a groove being turned in each for the reception of the rollers on the ends of the levers forming part of the clutch (not shown) actuated on the toggle system. The driven flange *C* has two slots machined out of it (both flanges being of gray iron) into which the split good grade machinery steel liners *M* and *M 2* are a sliding fit, having a certain amount of play allowed at right angles to the longitudinal axis of the shaft *S*, but being prevented from flying out when the clutch is thrown out of gear by a couple of pins running in a slot (not shown). These liners clamp together over the phosphor-bronze balls *D* by means of the bolts *E*, of which one only is shown and whose heads are counterbored into *M 2*. The balls *D* are reamed to receive the driving pins *K* which are of cast steel. Otherwise I think the drawing is self-explanatory. CHAS. V. RAPER.

Cheshire, England.

Annealing With Gray-Iron Chips.

At page 1728, Vol. 27, Mr. W. Osborne speaks of his success in annealing high-speed steel by heating and packing in gray-iron chips. While I, like Mr. Osborne, am unable to analyze the steel thus treated, I have experimented considerably with this method of annealing, and I have thought that perhaps my way of "sizing up" the matter might be of service to someone, or, at least, that I might have the satisfaction of knowing whether I am right or wrong.

Somewhat over a year ago I quite accidentally discovered the surprising annealing action of the gray-iron chips upon high-speed steel. A little later I had a milling cutter to make of Sanderson No. 5½ tool steel; said cutter to have a ¾-inch hole and to be 3 inches outside diameter by 2½ inches long. This piece of steel proved to be so hard that I annealed it in gray-iron chips before machining it, with the result that it was very soft and easy to work. It was then hardened and put into service, and did good work for quite a time, when it was desired to anneal and rebore it 1 inch, to be used on a larger milling machine whose smallest arbor was 1 inch. I annealed it as before in the gray-iron chips, with the same good results, as to annealing, as at first; but when it came to hardening, the steel refused to harden at the low heat at which this brand of steel usually does.

This and other instances which have come to my notice since this occurrence have strongly reminded me of what I have either read or heard somewhere—that gray-iron chips, heated, are to carbon what a sponge is to water; that is, they readily absorb the carbon from the steel, and at each successive annealing the steel deteriorates; a high-carbon steel soon becomes a low-carbon steel. There is quite a widespread idea that all or most high-speed steels contain no carbon; this is, I believe, entirely wrong, altho I am not prepared to say that the carbon in the high-speed steel is there for the same purpose for which it is put into steel of the old brands. I am inclined to believe that the gray-iron chips anneal readily because they absorb from the stock certain properties which were put there for the purpose of making the stock hard and making it possible to harden it at a low heat, and that annealing any carbon steel by this process is detrimental to the steel. In fact, it would seem, if this line of reasoning be correct, that we might a great deal better buy low-carbon stock in the first place and save the trouble of annealing and reducing a good high-carbon steel to about the same quality as the regular low-carbon steel.

To come back to high-carbon steel, we all know that the steel companies recommend taking a good cut off a piece of ordinary annealed tool steel, to, as they say, get rid of the soft layer which is found upon the outside of annealed bars. Now, if the steel companies' own process of annealing spoils the outside of the steel, and if we are able to anneal the high-speed steels, as Mr. Osborne says, much softer than the regular annealed bars by the use of gray-iron chips, isn't it at least reasonable to suppose that in softening the steel to so great an extent we *must* have taken away *something* which was put there for a specific purpose?

I heartily join in the hope which Mr. Osborne expresses "that someone can go further into the matter and find out what is the real nature of the change that takes place." I. W. ANTANO.

The three Diesel engines at the Tyrolean Alps at the Louisiana Purchase Exposition were each of 225 horse-power and ran at about two-thirds of their rated capacity. The work was measured at the switchboard. Indiana oil was used for fuel and cost 3 cents a gallon in car-tank lots. According to Prof. C. M. Woodward, the records worked out to 2.15 mills per horse-power-hour for fuel.

Things That are Usually Wrong—VII.

BY JOHN E. SWEET.

Where cored or other holes in castings are to be filled it is the common practise, pretty nearly the world over, to tap out the hole with a gas or other taper tap and plug it with a gas or other threaded plug. This is neither the cheapest nor the best way. If the hole is to be plugged for looks only, drill out the hole, turn a plug to fit and drive it in; if subject to steam or water pressure, ream the hole, turn the plug to fit and drive it in.

If not larger than 2 or 3 inches and driven with a machinist's hand hammer, nothing less than a hydraulic press or freezing water will force them out by direct pressure. Such plugs can be turned or planed off without unscrewing by the tool; the streak left by the thread when they are threaded in is avoided, and aside from the difference in the iron, they will not show. In the case of water-jacketed gas engines, freezing water may force them out and avoid a cracked jacket.

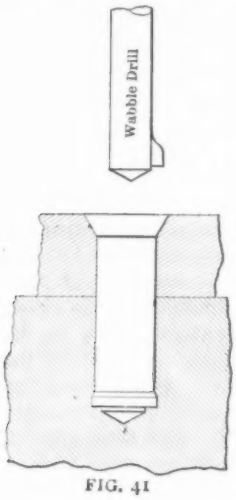


FIG. 41

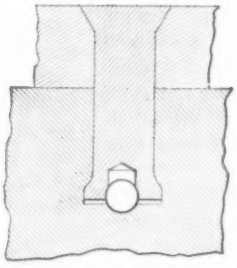


FIG. 42

THE RIGHT WAY.

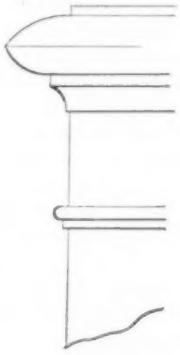


FIG. 43

The trouble with this scheme is to get mechanics to understand how much above any ordinary pressure it requires to force out a plug put in in this way.

Plugs 2¼ inches in diameter, ⅜ inch thick, tapering ⅝ inch to the foot, put in by hand and driven 1-16 inch, cannot be forced out by 200 pounds pressure to the square inch, and a light blow with a machinist's hammer drives them that far. These are the relief plugs in the pistons of the Straight-Line engines, and are made to be forced out by water in the cylinder. Those put in to stay should be parallel fits, as should everything else that is to be put in to stay.

A common tapering cut nail when compared with a pointed parallel wire nail is bad enough, but of all ridiculous things is the tang of a file made to be burned in the pith of a round stick, and its shape persists just as if auger bits and twist drills, which make straight parallel holes, had never been invented.

UPSETTING A RIVET AT THE BOTTOM OF A HOLE.

Where two pieces of metal are to be fastened with no room for bolt heads and nuts, screw rivets are usually employed. Pieces of wire or rods are put thru the outside piece, threaded into the other, cut off and riveted. A plain parallel drive fit in the lower piece is better than the thread, will hold more than it will take to break the other at the bottom of the thread, and it will never work loose. If something more secure is wanted, the rivet can be easily headed in the bottom of the hole. A very simple wabble drill will chamber the bottom of the hole, and if then the hole is drilled a little deeper with a smaller drill and the wire well driven, it will upset at the bottom, as shown in Fig. 41; or if the end is drilled and a ball set in, as shown in Fig. 42, it will upset also. This method is in use by the Link Belt Engineering Company.

UNFASTENED FALSE VALVE SEATS.

Years ago it was not an uncommon thing to put on false seats for the slide valves of locomotives. It was common practise to use screw rivets to secure them, and Henry Watkeys, master mechanic of the New York Central & Hudson River Railroad, proved himself a genius when he abandoned the use of all fastenings. He simply cast horns to fit inside the chest to hold the false seats in place and rightly assumed that the steam pressure that would hold the valve to its seat would hold the false face to its seat also. Knowing of this experience, it took no genius at all to conclude that a direct-connected engine and dynamo fitted to one complete base needed no bolting down to the foundation.

STEEL SMOKESTACK CONSTRUCTION.

In the construction of iron or steel smokestacks the common practise of shingling the second section over the outside of the first, and so on, putting the bottom of one section outside the one below, is all wrong where the stack is not brick-lined. The rain goes inside the stack as well as out, and that inside takes up the sulfuric acid from the soot and washes it into the joints between the sheets and rusts them out. Often this rust can be seen streaking down the outside. If the sheets are put together the other way, the upper sheet inside the lower, the acid does not get into the joint, and if water gets in it is fresh water; besides the joint can be calked or filled with putty and paint.

The objection is that the stack does not look as well, which may be because it is different from what we are used to seeing; but it opens up the way to make it look far better by following this plan: Make every section parallel, each section twice the thickness of the metal smaller than the one below. This will taper the stack from 4 inches to a foot, perhaps, according to hight, thickness of iron, etc., and if made part of this difference larger at the bottom and some smaller at the top there will be the same capacity and greater strength with a great improvement in looks. A properly designed cap will improve the draft and the looks, and there is no more reason why a stack should not look well than a building or a column. Fig. 43 shows as good a one as I have seen. It is simple, has practically the right slope at the top to insure what improvement is to be had in the draft, and comes so near good looks that nothing can be left off for its betterment.

Machine Shops in Smyrna.

Rufus W. Lane, American Consul at Smyrna, Turkey in Asia, reports as follows:

The Ottoman Railway Company, Smyrna to Aidin, has a large general machine shop for repairs to rolling stock, track, and bridge work. The company is about to construct a deep-water pier, the material for which is now being ordered. The pier will be of wood, iron, and stone. It is proposed to expend $800,000 to $1,000,000 in this work. One contract for about $30,000 worth of Pensacola pine was placed last year and another for about $50,000 has been signed recently, shipment to be made in January, 1905. Both of these orders are with American dealers and the result of a report from this office, published in *Consular Reports* for May, 1903.

The Smyrna Cassaba Prolongement Railway has large machine shops for the repair of rolling stock, bridges, etc. The Compagnie Ottoman des Eaux de Smyrne has an extensive machine shop for use in connection with the city water works. The Ottoman Gas Company of Smyrna has a large machine shop in connection with the city gas plant. The Compagnie Hamidiea des Bateaus de Smyrne has a machine shop and foundry. Issigonis Brothers have a machine shop and foundry. Rice Brothers have a general machine shop and foundry.

A Laboratory for Advanced Study, Practise and Research in Machine Construction.*

BY R. H. SMITH.

The Massachusetts Institute of Technology since its very foundation has aimed to provide instruction and laboratory practise in the practical application of science to manufacture and kindred industries. Not only has she kept pace with the best theory and practise of the times, but has also provided for the solution of new problems and advancing present conditions by establishing departments and laboratories for advanced study and research in engineering, electro-chemistry and in physico-chemistry.

New conditions and the growing demands of industrial life, however, place additional burdens on the Institute. In other branches of technical education there is a real demand and a large field for advanced study and research.

This may be truly called the age of machinery. Many of the great minds of the world are devoting their best thought not only to the invention and development of machinery in general, but also to improving present methods of machine construction.

The limited time allowed in an engineering course to the subject of machine-tool work cannot do much more than thoroughly teach the fundamental principles. While these give a student sufficient training to enter a manufacturing establishment and keep abreast of practise, still there is a rapidly growing demand for men who have had a more advanced training, men who have performed difficult problems in machine construction, both in theory and practise, men who have been trained to investigate, to experiment and to solve new problems.

The study of machine construction is such a large subject that it is impossible to do any advanced work, experimenting or research with present facilities, as the demand for the regular class work exceeds the accommodation.

Many of the larger manufacturing and industrial establishments conduct departments commonly called experimental departments, for the solution of difficult problems in their particular fields. Some have departments of invention. These, however, are managed by experienced men and there is no opportunity for others to acquire any information or training.

That there is a growing demand for advanced study and research is evidenced by the fact that students are continually asking for advanced work, students who have taken the regular course in machine-tool work and desire more training in the subject.

The solution of this problem would be to thoroughly equip an advanced machine laboratory with a large variety of the latest and most modern machine tools, such as cam cutting machines, gear cutting machines, thread milling machines, profiling and engraving machines, cylindrical and surface grinding machines, cutter and drill grinders, heavy turret lathe, automatic screw cutting machines, a variety of boring machines, drilling machines, high-speed lathes and planers, a variety of milling machines, an equipment of pneumatic tools and an air compressor for operating the same.

Some of these machines should be of the commercial type, and others equipped for the most delicate laboratory experiments and tests. Some should be large so that exhaustive tests may be made, some should be electrically driven so that tests could be made on the relative merits of steam and electric power for machine tools. In addition there should be an adequate equipment of the most modern small tools and measuring instruments, so that accurate measurements and tests may be made.

Adjacent to this advanced machine laboratory there should be a lecture room properly equipped with machine tools and small tools, also small drawing rooms for making designs, and rooms for consultations and special investigations. A special library should also be provided, supplied with all the best books and periodicals on the subject.

Provision should be made for a limited number of students who are proficient in drawing, mechanism, machine design, mathematics and machine-tool work, and who show capacity for advanced, experimental and research work. The apparatus should be sufficient to permit the whole class to work on subjects that have been discussed in the lectures.

It would be best to divide such a course into two parts. The first part should begin where the regular course leaves off, and give an advanced course in tool and jig work and machine building, involving the construction of a typical machine. Frequent visits should be made to manufacturing establishments and manufacturing processes studied. Weekly conferences of the class should be held to compare the results of each other's experiences.

The second part should be largely experimental and research work in testing the efficiency of machine tools, figuring cost of manufacture, experimenting on speeds and feeds and machine tools, testing different metals to find their efficiency for the various parts of machines and in testing the relative merits of the latest development in tool steel. The invention of high-speed steel for cutting tools is bound to revolutionize machine building, and tests to establish its efficiency would give valuable information. Suitable apparatus for investigations in hardening and tempering and case-hardening with the use of pyrometers would be valuable.

The course of study should be such and the equipment sufficient to give all of the class equal opportunities.

By establishing such a course, the Institute would further advance its prestige as a pioneer in teaching technical subjects and giving opportunities for advanced work that is now not attainable in any institution of learning in the world. Furthermore, it would give students an opportunity to acquire a training in a short time in the use of machines and machine tools, so that they could enter a manufacturing establishment with a personal knowledge of the most modern and economical processes of machine production and manufacture.

A distinguished educator has said: "A man may study some subjects too much, but he cannot study the English language too much." With the close relation of machinery to production to-day, it may be said that engineering students may study some subjects too much, but they cannot study machines and machinery too much.

A laboratory equipped with all the typical machine tools and apparatus used in manufacture, aside from the course of study pursued, would be of inestimable value to the Institute of Technology or any institution of learning, as it would be a museum of machinery for all its students.

*From *The Institute*.

The Engineering Army.*

The engineering army, like the myriads of well-trained, well-equipped and well-organized soldiers of the Mikado, stretches from high ground to high ground along an extended front, facing the hosts of conservatism who are entrenched behind moats of difficulties, redoubts of prejudices, batteries of tradition and in citadels of ignorance. Like the Japanese, the division commanders, looking well to their supplies of ammunition (*i. e.*, correct theories) and their daily rations (*i. e.*, materials of construction and shop practise), push forward now at one point and now at another, capturing hill after hill, now on the right, now on the left, and now in the center. The army of science never retreats; it forever forces back the frontiers of darkness, and solves problem after problem from the endless list of secrets with which the storehouses of nature are filled.

It is a glorious thing to belong to this engineering army, to rejoice in its triumphs and to share in its rewards. Its success is not accidental; its triumphs are not matters of chance. Engineering blood always tells. Just as we train our best soldiers and sailors at West Point and at Annapolis; and as our appliances at military and naval schools keep pace with the arts of war on land and sea; so our schools of engineering, if they are up-to-date institutions, keep pace in the theories they teach and in the laboratories they equip with the best engineering practise. Every advance at the front (to resume my simile) means an advance of all supplies and in

*Opening of an address by Calvin M. Woodward, chairman of Mechanical Science and Engineering section of the American Association for the Advancement of Science.

the enlisting and training of recruits. I am by profession a recruiting officer, and I am engaged with my fellow officers in training and equipping men for the firing line and the front rank. That the new material we send forward may be just what is wanted, we must have information as to the progress making and the next points of attack. In short, our schools of engineering must know the lines of engineering progress.

Echoes From the Oil Country—How the "Practical" Man is Made—A Gas Engine Paradox.

In a late article, "Introducing Gas Engines into the Oil Country," I see that I did not say what I had intended, at least in one place. In describing how the engine on the testing block was shut down I see that I said it was done by *shutting off* the gas, while the reverse was the case. *It was done by turning more gas on.*

It may not be entirely clear to all just how gas acts. If gas is added to air, the mixture will not burn or "explode," even under compression, until a certain amount has been added. Without saying what the proportion may be for any given kind of gas, it is still true that there is a minimum below which it is impossible to go and obtain the desired result. Taking the ordinary conditions in a two-cycle constant-compression engine and supposing that just enough gas is admitted to get an explosion, turn on a little more gas and the explosion is stronger, and will get stronger and stronger as more and more gas is admitted, up to a certain point. This point will be the point of maximum power to be obtained from that cylinder under those conditions of speed, compression, etc., and is not very hard to find by trial with the engine running. By continuing to make the mixture richer after this point is reached the force of the explosions is weakened until a point is reached where the explosions will not occur. At the beginning there were no explosions because of an insufficient supply of gas, and at the end they do not take place because there is an oversupply, and going to an engine that is not working up to where it should it is not safe to knock on more gas just because more power is wanted. It is more than an even chance that there is already too much on, because the ordinary man reasons from the steam engine. With it more steam means more work, and so of course if more power is needed from the gas engine most people turn on more gas.

I am not going to say what the proper mixture is to get the greatest amount of power, and my reason for not telling is a good one: I do not know what it is. This may be rather unsatisfactory to the man who is not a practical man, and I know that it is often hard to convince such an one that the practical man really does know anything worth considering, because he is ignorant of so much.

While I am willing to admit that I do not know what proportion of gas to air will give the greatest amount of power, I am far from admitting that because of that ignorance I cannot set an engine so that it will be working at that point. Here also may be a place where the man with experience in such things will agree with me and the man with only theory will not. Perhaps I can explain how it is done. There goes the telephone.

"Hello! Yes, I'm the man. You say your engine will not run. Oh, it will run but is not running as it should. I see now, and what is the matter? You don't know, eh, and you want me to tell you. All right, you just listen carefully to what I say. You know the place where you can change the setting of the valves, do you not? Well, all right, you go down to the engine and loosen up the lock-nut and move the valve a little."

Instantly comes back the question, "Which way shall I move it?" and I haven't seen his engine and haven't the least idea where he may have the valve set at the present time; but I am going to get him out of trouble just the same, if he only knows enough to follow my directions as I give them, and doesn't know enough to hunt up reasons for not doing as I tell him to do because I don't know anything about his particular case. There are some men who would rather have me spend half a day in going up there and doing what they can just as well do themselves, and if I went they would have a bill to pay, while if they did it there wouldn't be any bill—no, not even for the advice.

"Never you mind asking any questions until I get thru, and then if there is anything more I can tell you I am willing to try to do it. You are sure you know how to move it, aren't you? All right, then; but before you move it take a file and put a mark on it so you can put it back to where it is now if you want to do so. After that you move it a little and see what difference it makes on the engine. Never mind which way, only move it a *little* and notice what difference it makes on the engine. Do you understand? Yes, you just move it a little one way and see how it acts, and if it makes the engine act better you move it a little more, and keep on moving it in that direction as long as it makes things go better; but if that first moving makes the engine run worse, why then of course just move it the other way. Suppose you do shut it down, what have you got that mark for? Put it back where you started from and start up again. That engine knows better than I do where it will run best, and it will tell you all about it if you are willing to learn. All you need to do is to study the engine language a little. Yes, there are some more places where you can move things, but you had better try the easy places first, and be very careful to listen to what the engine tells you. How is that? Trouble? You can safely bet there are lots of chances of getting into all sorts of trouble. All you need to do is to go fussing around without using any brains, like some old woman trying to work charms, trusting to luck or to the prince of darkness, and you will have all sorts of trouble, but not half as much as you deserve. Just take your brains with you and do as I say and let me know how you get along. No, sir, I will not send a man over until I hear from you again. You haven't any more use for one than you have for a nursing bottle for personal use. Good by." And up goes the receiver, and another man is started on the road that leads to the land of practical men.

There never was yet the machine made that would not tell all about itself to the practical man who was willing to take the time to learn its language. When he thinks he knows it he ventures a little on the way he thinks is pointed out, and if there is a protest he retreats. It is of no use to use harsh methods, and I have also noticed that it is not always the most highly educated men who seem to learn the language the easiest. Indeed, it often happens that education begets a litter of theories whose voices effectually drown the voice of the machine. Generally, the voice of a machine is a very modest one, and this is especially the case when it is telling its valuable secrets. Occasionally a machine makes a very violent protest, but that is only when it is being misused to an unbearable extent. It pays well to listen long before that point is reached.

Did you never meet a highly educated foreigner who could not get rid of the brogue of his native land? Just so you will meet people who will never learn enough of the machine language to translate it correctly, and a man is a "practical" man to just the extent that he knows the language of the thing he is practical with, and no further.

When he gets so that he can read the language right off without having to spell out the words letter by letter, he becomes an "expert," and is up near the head of the class of "practical" men.

There is no use of your telling me that this is not so, you fellows who have never had a machine tell you anything. All of your testimony is negative while mine is positive. I know, for I have been on terms of intimacy with all sorts of machines for years, and I will say that I cannot recall a time when one ever told a lie, altho I must confess that I have often translated a word wrong, but that was not the fault of the machine that was talking to me.

W. Osborne.

Congress has passed the necessary resolution permitting the use of the ground near the Washington monument for the Railway Appliance Exhibition in connection with the International Railway Congress. The other conditions essential to the success of the exhibition seem to be already assured.

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Impact and the Yield Point in Steel Tests.

The paper which we publish elsewhere in this issue under the title of "Impact Tests of Wrought Steels" has been attracting a very great deal of attention in England, and no doubt here as well as there many people will be greatly surprised to be told that two pieces of steel showing practically the same tensile strength and not widely differing percentages of elongation may differ, so far as their power to resist shocks is concerned, in the ratio of 1 to 180, and that two other pieces, exactly alike in tensile strength and elongation may differ from each other in the ratio of 5 to 27 in respect to their ability to resist shocks. Such figures make us realize that tensile tests of steels may be exceedingly misleading, and in fact practically worthless for many purposes. This conviction is strengthened when we find that a given piece of steel simply oil-tempered (as they temper gun tubes) may have its tensile strength not materially changed by that treatment, tho its power to resist shock may be increased in the ratio of 7 to 165.

There are a good many engineers, however, who will not be so very much surprised at the results of these tests, and they are the men who have been giving attention to the "yield point" in making tensile tests. It is a fact of record, established by the most careful experiments, that there are certain conditions of steels that are plainly revealed by the yield point, but are not shown by the determination of the ultimate tensile strength. It will be found in every case that where a steel possesses the quality of resisting shocks, its yield point will be high—*i. e.*, it will be relatively near the breaking point, and this of course means that, in service, it will not begin to yield at all nor to change in any way until it is loaded nearly up to its ultimate strength.

The yield point of tool steel is very much higher than that of mild steel, and that is why it was found that a tool-steel piston-rod put into a steam hammer at the Crescent Steel Works in an emergency, did not, as was expected, break almost immediately, but far outlasted the mild-steel rods which had preceded it. Spring steel, which is probably the best of all for resisting shocks, has a yield point so very close to the ultimate strength that it can scarcely be discovered, and a steel which shows a drop at the yield point—*i. e.*, a steel which, as it is being pulled, reaches a point long before its ultimate strength is reached, at which there is a temporary drop of tensile strength in proportion to elongation has almost invariably been overheated, and is no good whatever for any purpose requiring strength and endurance.

The same facts are true of bronzes and of brass. Where the yield point of these is far below the ultimate strength, they are not to be relied upon, and tests showing their ultimate strength only are of little or no account.

On the Continent of Europe much attention has been given to the yield point: in England and in the United States very little attention has been paid to it. For that reason Continental engineers who have studied testing of materials will be very little surprised at the results shown by the tests referred to, while those in England and America who have given no attention to it, and who perhaps have dismissed it as a superfluous refinement, adding to the cost of testing but producing no other appreciable result, will be surprised.

Prof. Unwin has recently called attention to this important matter, and it is a thing which probably will not down. With suitable autographic recording apparatus the determination of the yield point is not difficult nor expensive. It is probable that it will come to be considered a necessary part of every test of steel designed to show what the steel really is and what it can be depended upon to do. It is a very grave mistake to dismiss it as unimportant, when so many competent engineers who have devoted much study to it declare that it is of the utmost importance and have placed upon record their experiments showing that it is so and the reasons for it.

The Engineer, commenting upon this matter, presents a theory as to what takes place when a specimen is struck by a falling tup and in support of said theory says: "It is worthy of note that experiment does rather tend to show that bars which have their yield points low in proportion to their stress limits stand well under shock tests." In this we think our contemporary is mistaken and that experiment shows decidedly the contrary.

Wear of Rails.

At the October meeting of the New England Street Railway Club Mr. H. M. Steward, roadmaster of the Elevated Division of the Boston Elevated Railway, read a remarkable paper on the wear of rails on the elevated and subway tracks of Boston. Wear upon the curves of these tracks takes place at a rate for which there is no precedent on steam roads. Diagrams were shown of the rails before and after use, the wear of the heads of rails made of ordinary commercial steel being over ¾ inch after forty-four days' use. Various kinds of steel have been experimented with and the wear greatly reduced. On a certain grade of hard steel the wear has been brought down to .18 inch, and on nickel steel to .53 inch after 204 days' use. Manganese steel shows .10 inch wear after 947 days' use.

Another direction in which the wear is different from that in steam tracks lies in the formation of corrugations on the surface. These corrugations seem to be largely due to the skidding of the wheels, altho this is but a partial explanation. An

engine driver may be kept spinning for some time on the rails without material injury to the rails, whereas, on the Boston roads, such spinning will cut the rails in two. Similar corrugations appear on other electric roads, but to nothing like the extent that they do on the Boston tracks. They are found only on curves, but, curiously enough, only on curves of comparatively large radius. Thus they are not found at all on curves of less than 500 feet radius, but with radii of over 1,000 feet they are very troublesome. Trains stalled on grades have worn grooves in the track which have made them helpless and made help necessary to move them.

Kind Words Borrowed from the U. S. Trade Reports.

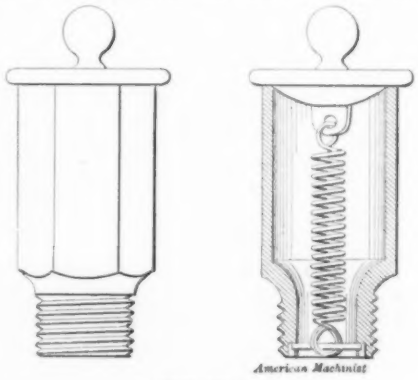
Among the amusing things that reach the office occasionally are items clipped from local papers and known as "kind words" spoken on behalf of local industries, which, after mentioning the distinguished and altogether praiseworthy citizens who are at the head of the said local industries, add something to the folowing effect: "The *United States Trade Reports* published in Cincinnati, Ohio, in a recent issue contained a most flattering comment upon this company and the excellence of their product." This, to one who knows what the *United States Trade Reports* is and the character of the alleged investigation upon which it bases its statements regarding various industries, is exceedingly funny, and of course the local paper, seeking only to say a good word for a local industry, is usually entirely innocent in the matter, and is unaware that of all the humbugs existing in the country the *United States Trade Reports* is the greatest; unless it be one of the two other similar papers which are devoted to the same kind of work, one of which is also published in Cincinnati and the other in Louisville, Ky. Which is the greatest humbug it is of course impossible to say, all seeming to be pure and unadulterated humbugs, having no circulation, having no expert knowledge of that which they write about, no means of acquiring such expert knowledge and possessing only a quality of ignorance about the various things treated by them, the density of which is one of the marvels of the age. It is by no means complimentary to the men at the head of a manufacturing business to have the business mentioned by the *United States Trade Reports*—quite the reverse.

Another correspondent sends us an "envelope stuffer" sent out by a certain manufacturing firm, which stuffer consists of a reprint of one of these articles by the *United States Trade Reports*. This shows only how easily this firm has been taken in by stuff, the very nature of which shows that it would not be printed in any reputable journal having readers mentally competent.

New Tools and Machine Shop Appliances.

A NEW OIL CUP.

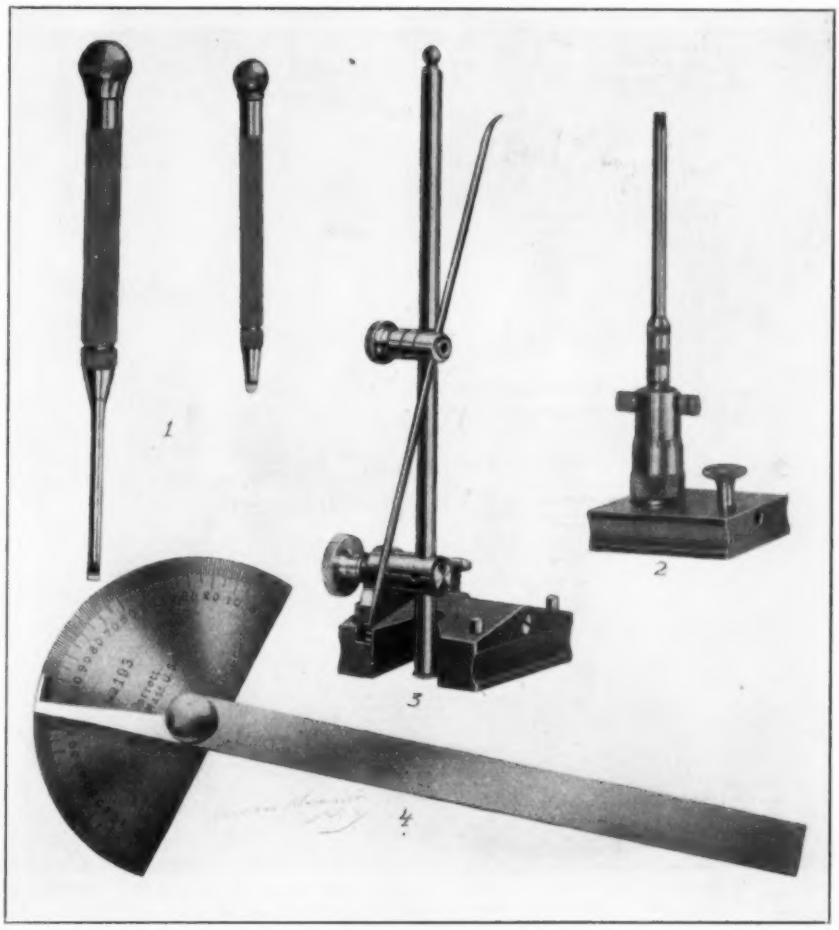
The illustrations show a new oil cup which is made by the Elliott Chemical Works, Newton, Mass. It is easily opened wide in any direction, and is closed instantly tightly and automatically by means of the spring. It can be poked open by the end of the oil-can spout in case one's other hand is otherwise engaged.



A NEW OIL CUP.

SOME NEW SMALL TOOLS.

The half-tones show some interesting additions to the valuable list of small tools made by the L. S. Starrett Company, Athol, Mass.



SOME NEW SMALL TOOLS.

The pocket screwdriver, Fig. 1, is made from steel tubing, nurled and nickel plated, in two sizes, the bodies being ¼ and ⅜ inch diameter, respectively. The butt of the blade fits a solid lock in the tube and a slight turn of the chuck secures it. The blade slips back into the handle and is secured in position there also by a turn of the chuck.

Fig. 2 shows a surface gage embodying the latest improvements of the manufacturers. It has a heavy base, grooved thru the bottom and end so that it can be used on circular work. The spindle passes thru a rotating head jointed to a rocking bracket making a universal joint so that the spindle may be set upright or at any angle or turned to work under the base. The scriber is held by the snug and head so that when the nut is loosened it is still held by spring pressure so that it can be set precisely as required before tightening. For small work the spindle may be removed and the scriber inserted in a smaller hole provided for it. The four-gage pins in the base are an important feature. These are frictionally held and may be pushed to bear against the edge of a surface plate or in the slot of a planer platen. These pins also adapt the gage to be used as a locomotive guide liner and for other work of kindred character. This gage is made

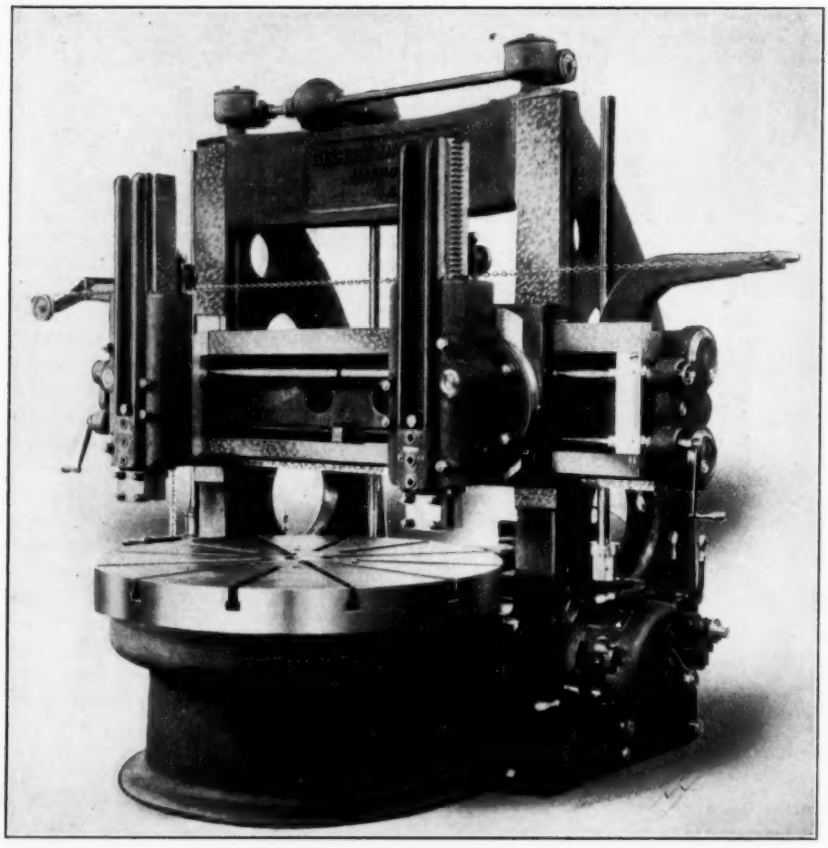
with two sizes of base and three lengths of spindles.

The protractor, Fig. 3, is graduated to read in either direction. The blade is 6 inches long, has a patent lock and is set firmly by a slight turn of the nut. The back of the tool is flat, making it handy for setting bevels, transferring angles and numerous similar uses.

Fig. 4 shows the use of a special base which has been provided for using the well-known inside micrometer of this firm as a hight gage. The hole in which the micrometer sets goes thru the base, the end of the "anvil" coming flush with the bottom; and the nurled screw at the side clamps it securely in position.

SIXTY-FOUR-INCH BORING AND TURNING MILL.

The accompanying illustration shows a recent product of the Gisholt Machine Company, 1315 Washington avenue, Madison, Wis., which has a number of novel features. The driving mechanism consists of a powerful friction back-geared headstock with three ratios of gearing obtained thru sliding gears. This form of headstock gives entire independence between the drive proper and the table control. The drive is of the single-chain. The two tool heads are independent and are controlled by feed mechanism located on each side of the machine. A safety device prevents injury should the heads be run together thru careless handling and an automatic tripping device trips the feed at any predetermined position. Rapid power traverse of the heads is provided, the movement of a lever throwing the feed out and the traverse in, the feed being automatically continued at any point by releasing the lever. Other features of the machine are similar to the 42-inch machine which was illustrated at page 911, Vol. 27.

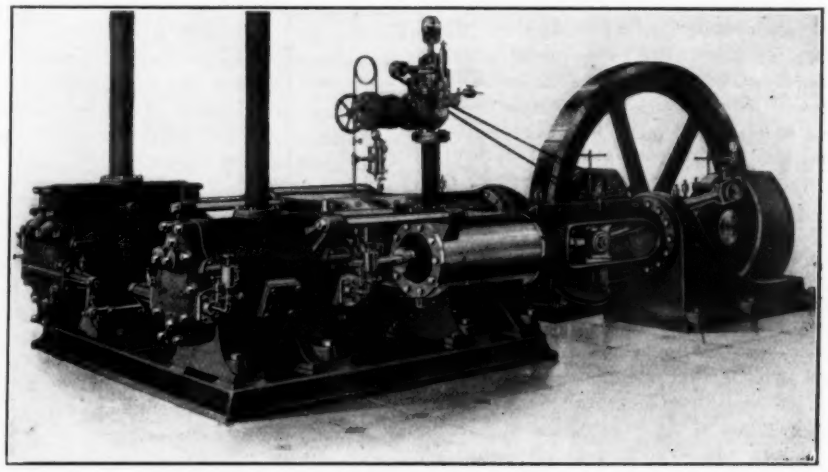


64-INCH BORING AND TURNING MILL.

pulley constant-speed variety, and is adapted to motor driving by mounting the motor directly on the headstock and without increasing the floor space occupied, the connection being by either gears or a silent

A NEW FRANKLIN AIR COMPRESSOR.

The air compressor here shown was built by the Chicago Pneumatic Tool Company at its Franklin (Pa.) plant, and is a sample of those recently placed in the new shops of the Pennsylvania Railroad at Altoona. The machine is designated by the builders as "Class C. S. C.," both the steam and the air cylinders being compounded, the diameters of the former being 11 and 20 inches and of the latter 11 and 18 inches, with a common stroke of 24 inches, the normal speed being 100 revolutions per minute, which gives a theoretical capacity of 700 cubic feet of free air per minute. Attention is called to the unusual length of stroke in this compressor, which minimizes the clearance losses and gives a less frequent valve action for the required piston speed. The normal steam pressure is 100 pounds, running without a condenser. Most of the power developed is of course transmitted directly from each steam cylinder to its own air cylinder, so that at no portion of the cycle of operations is the crankshaft subjected to the same driving stresses as in an independent steam engine. The bearings and all wearing parts have nevertheless been provided in generous proportion, with effective provision for adjustment. The steam cylinders have the Myer adjustable cut-off, and the main valves are double ported, both high- and low-pressure valves being balanced. The air cylinders have mechanically operated inlet valves of the Corliss type, these being placed in the cylinder heads and thus minimizing the clearance. They are operated by the steam cut-off eccentrics. Pressed steel poppet valves are used for the discharge, the valves, valve seats and guides being readily accessible and removable. An intercooler is of course used between the two stages of the compression. It is not shown in the photograph and may be located as most convenient between or near the compression cylinders. The placing of the valves in the heads permits a more complete and effective water jacketing than is usually obtained. The governor operates in connection with

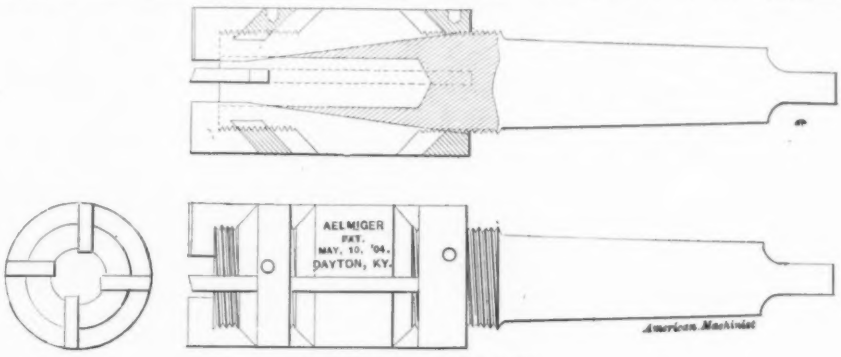


A NEW FRANKLIN AIR COMPRESSOR.

a pressure regulator which controls the speed according to the requirements. It has also a safety stop which prevents running away if the belt breaks. The cylinders are all doweled to a box section sole plate and are also connected by tie rods.

ADJUSTABLE HOLLOW MILL.

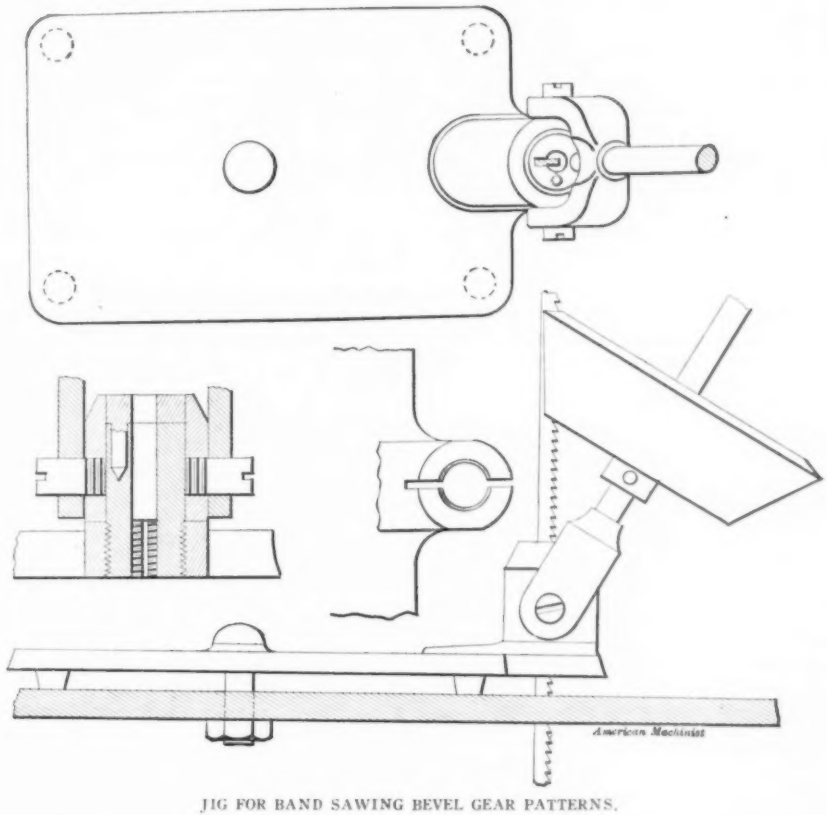
This hollow mill can be readily adjusted to compensate for wear and grinding of the blades and also to adjust the cutting edges of the blades toward or from each other, so that the work may be turned to any size desired. The blades are milled at the inner edge to suit the incline of the slot bottoms and are adjusted and clamped by two threaded collars fitted at the ends of the body, the front collar passing, as shown, thru a slot milled thru each blade, thus forming a means by which the blades are drawn in either direction. The slot referred to and the rear ends of the blades and the opposing faces of the collars being finished at an angle, cause the blades to be drawn down tight on their seats when the threaded collars are tightened. The tool may be used as a counterbore by inserting a pilot of the desired size in the bore of the body. The maker is Albert Elmiger, 624 Sixth avenue, Dayton, Ky.



ADJUSTABLE HOLLOW MILL.

JIG FOR BAND SAWING BEVEL GEAR PATTERNS.

The band-saw attachment here shown, the operation of which is sufficiently evident without explanation, has recently been patented by M. L. King, Ames, Iowa. The spindle upon which the pattern is mounted is pivoted on a line coincident with the points of the saw teeth and the pattern is then mounted upon the spindle at such a hight as to bring the apex of the gear cone to coincide with the center of the pivot. The hub of the base of the jig is slit so that it slips over the saw and it is fastened in position by a single bolt, with of course dowel pins or other means for locating it correctly. The teeth are laid out at the large ends and the operator simply works to the marks. It would seem that a templet system might be applied to the jig which would avoid most of the laying out.



JIG FOR BAND SAWING BEVEL GEAR PATTERNS.

The collection which the Goldschmidt Thermit Company had as an exhibit at St Louis has at the request of the authorities been placed in the National Museum at Washington.

Union Engineering Building.

At the meeting of the Conference Committee on the Union Engineering Building, held January 7, Mr. Alfred R. Wolff was unanimously appointed consulting engineer for the heating and ventilation of both the Union Engineering Building and the Engineers' Club to be erected at Thirty-ninth and Fortieth streets under the Carnegie gift to engineering of $1,500,000. Mr. C. O. Mailloux was selected as the consulting electrical engineer for the Union Engineering Building, and the firm of Bates & Neilson were selected as consulting electrical engineers for the Engineers' Club. All these gentlemen are well known in connection with the execution of large work of the class named in New York and vicinity, in addition to which they are prominently identified with the organizations that will occupy the buildings in question. Mr. Wolff and Messrs. Bates and Neilson are also members of the Engineers' Club of some years' standing, and Mr. Putnam A. Bates was for a long time district engineer for all the Crocker-Wheeler installations in the New York territory.

Tools Wanted by the Isthmian Canal Commission.

The Isthmian Canal Commission, Washington, D. C., is inviting proposals to furnish a lot of small tools and supplies, such as are used in machine shops and also for a number of machine tools ranging from 10-inch toolmakers' lathes to larger and heavier tools, such as driving-wheel lathes, planers, etc. Blank forms of proposals and full information by addressing the commission as above.

The Refrigerating Engineers.

The following is a list of officers for the current year of the recently organized American Society of Refrigerating Engineers:

President—John E. Starr.

Vice-Presidents—P. de C. Ball and H. B. Roelker.

Treasurer—Walter C. Reid.

Governors—W. E. Parsons, Henry Torrance, Jr., E. L. Phillips, D. S. Jacobus, L. H. Jenks, Louis Block, Edgar Penny, W. T. Robinson, Thomas Shipley.

The George Gorton Machine Company, Racine, Wis., sends us a unique New Year's card, which is a piece of German silver engraved on one of its machines instead of being printed in the ordinary way on paper. It is a fine example of what the machine will do.

Personal.

Charles Churchill, of London, is visiting his friends in America.

William Baker, who for some time has had charge of the drop-forge and die departments of the Remington Arms Company at Ilion, N. Y., has resigned and will take charge of similar work at the Locomobile Works, Bridgeport, Conn.

On January 5 George A. Howells was given a testimonial in recognition of the completion of his twenty-fifth year with the Rand Drill Company. There was a gathering of his associates and the officers of the company presented him with a handsome loving cup.

L. T. Wilmarth, who has until recently owned a controlling interest in the firm of Wilmarth & Morman Company, and who retired from the position as manager of that company January 1, still retains an interest in that concern and is also an officer in several other manufacturing concerns in Grand Rapids, which, as he puts it, are entirely sufficient to keep him out of mischief; and he will remain in that city.

E. D. Leavitt, the well-known engineer, an ex-president of the American Society of Mechanical Engineers, upon the occasion of his closing his offices at Cambridge, Mass., and practically retiring from the active duties of his profession, was presented with a handsome silver service by thirty-eight of his former associates now located in Boston, New York, Philadelphia and elsewhere. Mr. Leavitt will retain his position as consulting engineer of the Calumet & Hecla Mining Company.

Obituary.

Steven A. Ginna, a large manufacturer of tin cans and other tin goods in New York for many years, and more recently president of a detinning company, died suddenly at the Astor House, New York, on January 15, as a result of a stroke of apoplexy, in his sixty-eighth year.

The Engineer, London, announces the death, at Preston, of John Waterworth, the oldest ex-engine driver in the world, eighty-five years old. He was always known as "Red Jack" and in thirty-seven years' service he ran over 2,000,000 miles without an accident. He was always selected to drive the Royal train over his section.

Edward L. Phillips, president of the Hewes & Phillips Iron Works, Newark, N. J., died January 14, fifty-four years old. Mr. Phillips was one of the five sons of the late John M. Phillips, founder of the Hewes & Phillips firm. He was a graduate of Cornell University and served a regular apprenticeship in the shops of the company. On the day of his death he had been sailing an ice boat and was stricken with apoplexy on the way to his home.

George C. Howard, proprietor of the Howard Machine Works, Lansdowne, Pa., died January 14. The Howard business was founded in 1840 by Mr. Howard's father, and in 1846 the firm became William H. Howard & Son. Both father and son were successful and distinguished inventors. They made the machines for separating stamps and also plate printing presses. In 1861 Mr. Howard was chosen to build the trimming and separating machinery for cutting the Treasury notes. From this beginning the present Bureau of Engraving and Printing has grown.

Ralph Little Whyte, whose revelations regarding the invention of the Stephenson link motion appeared in these columns at pages 178 and 924, Vol. 27, died at his home in Hamilton, Ontario, on Wednesday, January 11. Mr. Whyte was born at Newcastle, England, in the year 1820. He was a man of upright character and sterling principles, and was highly respected by all with whom he came in contact. That part of his long and useful life which is of most interest to the readers of this paper was his connection with the works of Robert Stephenson & Co., Newcastle, England. Mr. Whyte was chief draftsman there when the link motion was invented, and he has bitterly denounced those responsible for the deflection of the credit of this invention from William Williams to William Howe.

Self-Education for Mechanics, published by The Industrial Publication Company, 16 Thomas street, New York, has just finished its second year of publication, following very closely the line indicated by its title. It is announced that, without change of name, the publication is hereafter to be conducted in the interest of and for the special edification of carpenters. The apparent narrowing of its field should be really a vast enlargement of its constituency.

Business Items.

The Bristol Company has been awarded a gold medal for their recording instruments exhibited at the St. Louis Exposition.

The Philadelphia Gear Works, 125 North Seventh street, Philadelphia, Pa., report that business has greatly improved since January 1, and orders are coming in good shape.

Mr. Alfred H. Schutte will, in addition to his New York office, continue under his own name the showrooms and offices at Cologne, Germany; Brussels and Liege, Belgium; Paris; Milan, Italy, and Bilbao, Spain, formerly carried on under the name of Schuchardt & Schutte.

The Vandyck Churchill Company, general machine tool dealers in New York and Philadelphia, has secured the services of Mr. W. W. Nichols, who will travel for it in northeastern Pennsylvania. Mr. Nichols for the past year was road representative of the Diamond Drill & Machine Company, and before that was connected with W. E. Shipley, of Philadelphia.

The National Acme Manufacturing Company, Cleveland, Ohio, has removed its Western office to more commodious quarters at 63 South Canal street, Chicago. This was made necessary on account of the rapidly increasing business in the territory controlled by that office. Mr. A. B. Breeze, the manager, has had his working force increased by the appointment of Mr. J. T. Donahue, as assistant.

Wells Bros. & Co., Greenfield, Mass., owing to their rapidly increasing business in Europe and other foreign countries, have just opened a large store at 149 Queen Victoria street, London, E. C., England. Mr. Theodore Butler will be their resident representative. This store will be a distributing point, and they will carry in stock a complete line of their Little Giant screw plates, taps, dies, countersinks, reamers, bolt cutters, nut tappers, etc.

The Electric Controller & Supply Company, Cleveland, O., has placed Mr. Geo. Magalhaes in charge of its Eastern office, at 136 Liberty street, New York city. Mr. Magalhaes is a graduate of the Columbia University and has been connected with the engineering department of the company for some time. He is thoroughly familiar with the company's products, chief of which are reversing controllers, solenoids, lifting magnets, magnetic switch controllers for reversing or non-reversing motors driving heavy machinery, direct-connected variable-speed motor drive for planers, etc.

The Cincinnati Planer Company, Cincinnati, O., has increased its capital stock to $200,000, and elected the following officers: C. H. M. Atkins, president; B. B. Quillen, secretary and treasurer; Geo. Langen, general superintendent. These officers, together with E. N. Atkins and C. M. Quillen, make up the directory. W. H. Burtner, former president of the company, retires on account of poor health. Mr. Atkins, the new president, is also president of the Warner Elevator Company and of the Norwood National Bank, and is connected with several other leading concerns of Cincinnati.

The Burt Manufacturing Company, Akron, Ohio, has made the following recent shipments of oil filters: Havana (Cuba) Agency, twenty-one; Sydney, Australia, nine; St. Petersburg, eighteen; Calcutta, three; Spain, four; National Tube Company, McKeesport, Pa., one; Munising Paper Company, Munising, Mich., one; Atlantic Mills, Providence, one; United States Coal & Coke Company, West Virginia, one; Singer Sewing Machine Company, one. The company has also shipped exhaust heads as follows: Sydney, six; London, two; one each to American Steel & Wire Company, National Steel & Wire Company, Crane Company, Power House, San Jose, Cal.

Turbo-generator contracts closed by the Westinghouse Electric & Manufacturing Company during the last week of 1904 included two 1,000-kilowatt outfits for the Haverhill (Mass.) Electric Company, to be used in lighting and power work in that city; two 1,500-kilowatt outfits for the Rochester, Syracuse & Eastern Railroad, and one 1,000-kilowatt outfit, with exciter, for the Springfield Electric Light Company Springfield, Mass.; also a 300-kilowatt turbo-generator, with exciter, for the Northern Electric & Manufacturing Company, of Montreal. The Springfield Electric Light Company's contract also included two 500-kilowatt rotary converters and four 300-kilowatt transformers. The Westinghouse Electric & Manufacturing Company has also closed a contract with the Ontario Power Company for an alternating current generator with a rated output of 10,000 horse-power at 85 per cent. power factor. This is in addition to three other machines of similar type which the Westinghouse Company is furnishing for this plant. The generators are of the revolving-field, two-bearing type, designed for direct connection to waterwheels; they generate three-phase current at 12,000 volts and 25 cycles, and run at a speed of 187½ revolutions per minute. Among other apparatus included in the contracts are twelve 3,000-kilowatt, oil-insulated, water-

cooled transformers, wound for 12,000 and 60,000 volts; two 375-kilowatt exciters and complete switchboards.

Mr. Charles A. Moore on January 9 purchased the entire interests of Mr. Henry S. Manning in the firm of Manning, Maxwell & Moore, together with Mr. Manning's interests in the following manufacturing concerns: the Ashcroft Manufacturing Company, Consolidated Safety Valve Company, Hayden & Derby Manufacturing Company and Hancock Inspirator Company. Mr. Manning's reasons for retiring are due to his desire to retire from business and be relieved of business cares and problems. There will be no change in the name or character of the firm of Manning, Maxwell & Moore, and its business in the future will be conducted by Mr. Moore and the men who have been associated with him. The firm of Manning, Maxwell & Moore was organized in 1881, being the successors of the firm of H. S. Manning & Co., which was started in 1873. The growth of the business has been steady and constant, and the firm now has branch offices in Chicago, Cleveland, St. Louis, Pittsburg, Boston and Philadelphia. Various manufacturing interests have been acquired from time to time, so that to-day the firm is interested in the manufacturing industries of the Ashcroft Manufacturing Company, manufacturing steam gages, indicators, pipe-fitting tools, etc.; Consolidated Safety Valve Company, manufacturing safety valves; Hayden & Derby Manufacturing Company, manufacturing injectors and ejectors; Hancock Inspirator Company, manufacturing inspirators and valves of various kinds, and the Shaw Electric Crane Company, manufacturing electric traveling cranes.

Manufacturers.

The Kearny, N. J., town council is about to build a municipal electric plant.

A cooperage plant of J. C. Rouse, Williamsburg, New York city, has been burned.

The Coshocton (O.) Glass Company has decided to considerably enlarge its plant.

Plans are being drafted for the new plant of the Muskegon (Mich.) Boiler Works.

The Standard Oil Company may enlarge its refining works in the Kansas City district.

The Worth Bros.' Company has broken ground for another tube mill at Coatesville, Pa.

P. R. Vail, of Ely, Minn., proposes to build a brewery at some point on the Mesaba range.

The Standard Marble Works, 706 West Front street, Cincinnati, O., have been burned.

A steel mill at Peru, Ind., may be rebuilt. The Commercial Club is conversant with the project.

The plant of the Kewanee (Ill.) Mining & Manufacturing Company is reported to have been burned.

The Harroun grain elevator in Harlem, a suburb of Kansas City, Mo., is reported to have been burned.

Work has begun on a factory building for James H. Billington Company, manufacturers' supplies, Philadelphia, Pa.

Five factory buildings are proposed to be erected at Chester, Pa., for the Philadelphia Quartz Company, Philadelphia, Pa.

We understand that the Spaulding & Frost Company, Fremont, N. H., cooperage, etc., has extensive improvements in view.

The Eastern Steel Company, Pottsville, Pa., has acquired more properties in Fishbach for the purpose of extending its plant, etc.

Hatch Brothers' brick works, at Fish House, on the outskirts of Camden, N. J., have been damaged by fire. The boilerhouse was saved.

The Free Methodist Publishing House, now having an establishment at 14 North Ann street, Chicago, Ill., will erect a larger printing house.

The White Pine Copper Company, which has properties at Ely, Nev., will probably be equipped with a mill.

Alton Parkhurst has been granted a permit for a two-story and basement brick factory at 48-50 St. Johns place, Chicago, at an estimated cost of $25,000.

A new industry, the Dairy Machine Manufacturing Company, has secured the plant formerly used by the Birmingham Brass Company at Shelton, Conn.

The Beets Adder & Manufacturing Company has been organized in Detroit, Mich. A factory will be erected. Detroit and Defiance, O., capital is interested.

It is stated at Anoka, Minn., that Case Brothers will soon commence the erection of a new factory for the manufacture of sash, doors and cabinet work.

The W. S. Tyler Company, manufacturer of wire cloth and ornamental metal works, Cleveland, O., will erect an addition to the present plant on St. Clair street.

Gus Schulte, of the shoe firm Aschenbach & Schulte, Houston, Tex., is about to establish a plant for the preparation of Llano granite for building purposes.

Men interested in building a sugar factory in Davenport, Ia., have met in the secretary's room of the Business Men's Association and signed articles of incorporation.

Plans have been completed for a new jewelry factory to be erected by James E. Blake, of Attleboro, Mass. It will have four floors, of about 20,000 square feet each.

We understand that the large manufacturing plant of the Canada Carriage Company, at Brockville, Ont., has been destroyed or damaged by fire and will be rebuilt.

W. J. Oliver, Knoxville, Tenn., has purchased nine acres near the Wm. J. Oliver Manufacturing Company machine shops, and will erect a large car wheel foundry.

Frank Torrence, Springfield, O., is organizing a stock company for the manufacture of the automatic switch-closing device invented by Frank Bayless, colored, of that city.

The Union Scale Company Boston, Mass., has bought factory property in South Boston, which it intends to improve extensively by the erection of a foundry and otherwise.

The Hartford (Vt.) Chair Company, whose establishment there was recently damaged by fire, has made a proposition looking to possible building in Brattleboro, increasing its plant.

The Buchanan & Bolt Wire Company, Holyoke, Mass., has awarded the contract for a new building. It will be equipped with machinery for the manufacture of wire cloth and other specialties.

The city council, Sauk Center, Minn., has been considering a proposition made by a company that manufactures apparatus for the production of acetylene gas relative to the location of a factory there.

The Wagner Lake Ice & Coal Company, Cincinnati, O., has purchased the plant of the People's Ice & Refrigerating Company, that city. The plant will be enlarged and a big cold-storage building erected.

The Imbler Fence Machine Company, a new corporation, has leased a building at Zionsville, Ind., and is installing machinery to manufacture a new design of wire fence. The plant is about ready for work.

The Royal Weaving Company, of Pawtucket, R. I., and elsewhere, intends to increase its capital stock from $1,000,000 to an amount not exceeding $2,000,000. It is proposed to erect another mill.

The Crompton & Knowles Loom Works, Worcester, Mass., will erect at once a foundry building as a part of the Philadelphia branch. Plans for the foundry have been prepared by Thompson & Gallagher, Worcester.

A foundry of the American Car & Foundry Company at Berwick, Pa., has been burned. It will probably not be rebuilt. The upper works will be removed to West Berwick, where a new foundry is to be erected.

Manager John H. Wooton, of the Utah County Light & Power Company, has prepared details for the erection of a large light and power plant for American Fork, Utah, to be operated by both water and steam power.

Negotiations are pending between the Merchants' Association, York, Pa., and Liebe & Co., of New York State, that may result in the establishment of another silk mill in York. The concern named is in the ribbon business.

It is rumored, but not verified that the Santa Fe has made arrangements with Captain John Seaton, of Atchison, Kan., to establish a foundry in Topeka for car wheels. The matter has been under consideration for over two years.

C. E. Schermerhorn, architect, 430 Walnut street, Philadelphia, has prepared plans for a manufacturing plant covering four acres of ground, to be located in the Twenty-fifth Ward. The main machinery building will be 361x81 feet.

The power building of the Ajax Dynamite Works, owned by H. H. Thomas, near Kawkawlin, Mich., has been destroyed by fire. In it were a 60 horse-power boiler and 40 horse-power engine, with several steam pumps and grinding mills.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has increased its capital stock from $500,000 to $1,000,000. A new power-house will be built and equipped and 25 per cent. more men are to be employed. The company is said to hold over seventy patents on electric car lighting apparatus.

Sears, Roebuck & Co., the big Chicago mail-order house, have bought a factory at Meriden, Conn., which they will run under the name Meriden Firearms Company. They are moving there from Hopkinton, Mass., the Fyrberg Arms Company plant, which they control, and may consolidate with it other plants. The erection of an additional building, 40x100 feet, two stories, is projected.

New Catalogs.

W. M. Pattison Machinery Company, Cleveland, Ohio. Folder illustrating drill press vises made by this company.

The Oesterlein Machine Company, Cincinnati, O. Descriptive folder of universal cutter and tool grinder No. 2, illustrated.

The General Pneumatic Tool Company, Montour Falls, N. Y. "Electric Hoists," Bulletin No. 56, illustrated by half-tones and drawings.

Electro Dynamic Company, Bayonne, N. J. Circulars Nos. 1, 2 and 3 of design, construction and application of inter-pole, variable-speed motors. Illustrated.

The Heald Machine Company, Worcester, Mass. This company has sent out an illustrated folder directing attention to its line of grinding machines and attachments.

Canadian Corundum Company, Hamilton, Canada. General catalog of standard and special emery and corundum wheels, polishing wheels, grinding and polishing machinery, accessories and supplies. Illustrated. 6x9, pp. 76, paper.

The Reed Manufacturing Company, Erie, Pa. "Reed Tools." This is an attractive and well-arranged catalog showing a large line

of stocks and dies, pipe vises, combination vises, pipe cutters, pipe taps and reamers, pipe tool sets, wrenches, etc. The catalog is replete with half-tone illustrations and is appended by a number of pages of tables and data valuable to users of this class of tools. 6x9, pp. 51, paper.

Ingersoll-Sergeant Drill Company, 26 Cortlandt street, New York. 1905 catalog of coal-mining machinery, including coal cutters, coal and rock drills, air compressors and equipment, with full descriptions and many illustrations from photographs. A number of pages of tables, data and general information are given, and the catalog will be of use to all interested in this line of equipment. 6x9, pp. 134, paper.

The Ingersoll-Sergeant Drill Company, 26 Cortlandt street, New York. 1905 edition of Catalog No. 35. This really consists of advance sheets of Catalog No. 36, and contains information additional to that appearing in the first edition of No. 35. There are new views of several important installations, including those of the Cleveland Stone Company and the Mare Island Navy Yard. Air receivers and inter- and after-coolers are also given. The complete catalog No. 36 will appear later in the year. 7x10, pp. 100, paper.

Goodell-Pratt Company, Greenfield, Mass. 1905 catalog of tools made by this company. Among the many tools illustrated are automatic drills, reciprocating drills, breast drills, chain drills, bench drills, wall drilling machines, drill chucks, automatic screw-drivers, bench screw-drivers and special screw-drivers; also a large line of hack-saw blades and frames, bench and power hack-saws; ratchet braces, bench levels, grinding and polishing heads, tool sets, squares, gages, etc. 6x9, pp. 176. A pocket edition of this catalog is issued for general distribution.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Addressing machines for office use. Joline & Co., 123 Liberty St. New York.

Designer of tool and automatic machinery. Fred Mill, East View, Cincinnati, O.

Light mach'y to order; model work; rubber molds. J. W. Weir, Bridgeport, Conn.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Drafting, machine, engine or power plant designing; low rates. Box 16, Youngstown, O.

A set of steel figures, size 3-32 or ⅛ in.; $1.25, post paid. J. L. Lucas, Bridgeport, Ct.

If you need working drawings properly done, write to Geo. Schwartz, M. E., 52 Broadway, N. Y. City.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Wanted—In good condition, a 50 horse-power upright engine. Address Milton F. Williams Mfg. Co., St. Louis, Mo.

Auto. machinery of all kinds designed and built; hardened and ground work, flat or circular. Wiebking, Hardinge & Co., Chicago.

The Canada Machinery Company, Limited, Sarnia, Canada, have the facilities and are open to manufacture, for patentees and others, machines and machinery for the Canadian market.

Wanted—To furnish competent men for positions as managers and heads of departments in the metal-working or machine business, and the past experience of each, for which there is no charge; also want competent men to register for such positions. Address James Brady, 168 Lefferts Place, Brooklyn, N. Y.

Business Opportunities.

Would like to combine with capital to patent and build here, in Ohio, several good, new articles (tool line); in actual use as a test. "Experienced Machinist," care AM. M.

An advantageous proposition is open to a technical man with from $5,000 to $10,000 capital, to acquire interest in profitable machine business and patents left in an estate; good designer and hustling superintendent wanted. "Partnership," care AMER. MACH.

Successful and thorough salesman, commercial and office man, young, energetic and well known in machine trade, seeks position, partnership or interest in some machine, supply or tool business, where his talents will count; can invest up to $25,000. Address Box 172, AMERICAN MACHINIST.

Manager of a prosperous manufacturing company desires to retire; a competent mechanical engineer can secure position by purchasing an interest of $20,000; salary and dividends exceed $5,000; the right man can double this in a few years. Address Box 177, AMERICAN MACHINIST.

For Sale.

I. C. S. complete Mechanical Engineering, also drawing outfit. Address T. H., care A. M.

For Sale—A going machine shop; large future possibilities; cause of sale death in firm. W. D. Judson, New Haven, Conn.

For Sale—In New York city, an established pattern shop with first-class equipment. Address "Patterns," care AMER. MACHINIST.

For Sale—Books of the International Correspondence Schools; complete electrical engineering course books; never used. Box 178, AMERICAN MACHINIST.

For Sale—One set standard internal cylindrical gauges or plugs, from 1-16 in. to 2 in., varying by sixteenths; gauges are new; never been used; will sell very cheap. Address John Imschweiler, 5 Ogden Court, Rochester, N. Y.

I can sell your machine shop (or other business), with or without real estate, no matter where it is or what it is worth. Send description, state price and learn how. W. M. Ostrander 111 North American Bldg., Philadelphia.

For Sale—United States patent No. 719,-854, 1903, for best water gage in the world; now giving splendid results on English market; see description on page 788, December issue of POWER. Apply James Robinson, G. P. O. Leeds, England.

For Sale—10 in. lathe patterns, drawings, jigs, templets, special tools and everything else necessary to manufacture the best 10 in. engine lathe on the market; no experiment; easy terms. Address The R. K. Le Blond Machine Tool Co., Cincinnati, O.

For Sale—A controlling interest in a small manufacturing and jobbing machine shop in growing city in southern Michigan; well-established business; a splendid chance for a young machinist ambitious to have a shop and business of his own. Address A. B. C., care AMERICAN MACHINIST.

For Sale—A modern machine shop, complete with water power, suitable for manufacturing and jobbing purposes; is now running at Londonderry, Vt.; cause of selling, death of proprietor. Address Mrs. H. A. Hayward Londonderry, Vt.; or Kansas City Machine Works, Kansas City, Mo.

For Sale—At very low prices two 60 H.-P. horizontal tubular boilers, one 80 H.-P. engine, together with stack, heater, pump and other appurtenances, all in excellent running order; also a lot of shafting, pulleys and belting, nearly new, purchased within a year or so past for running our temporary shops. This machinery is sold because we are moving into our new shops, having a larger power plant with all machines direct motor driven. Schedules sent on application. Ferracute Machine Company, Bridgeton, N. J.

Modern machine shop building for sale, cheap, on easy terms, or lease. This factory property is located on the Central Railroad of New Jersey, at Greenville Station, Jersey City, 16 minutes from Liberty St. Ferry, New York. The ground is 100 ft. by 200 ft., and has a railroad siding into the building. The building is modern brick and structural steel, with 80 ft. cross-section, 40 ft. erecting space and two 20 ft. bays on each side; electric crane runway, 27 ft. high, and supports 20 tons; Whiting foundry; 8-ton electric crane; 30 H.-P. engine; 50 H.-P. boiler; 20 K. W. C & C generator for operating crane and electric lights; toolroom all fitted with bins and shelving; small pattern shop and separate stockroom, enclosed with wire netting. Building 60 ft. long. Temporary frame end to allow for extension. Offices fitted in ash and ground glass; private office, bookkeepers' and general office, drafting room, lavatories, etc. Best class of machinist help living near factory. Apply Greenville Coal & Ice Co., 96 Garfield ave., or on property, at Greenville Station.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona-fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Position as mechanical engineer or superintendent desired by young man having practical experience and holding degree. Address 179, AMERICAN MACHINIST.

CONNECTICUT.

Mechanical draftsman, 26, a technical graduate with 4 years' practical experience, best references, wishes to change. Box 180, A. M.

ENGLAND.

By an up-to-date engineer responsible position in building steam turbines; long experience; best of references; free after February 1; West preferred. Box 173, AMER. MACH.

ILLINOIS.

Broadly qualified machine works general superintendent, desiring new location, invites confidential inquiries; state particulars. "Conservant," care AMERICAN MACHINIST.

Machinery salesman, practical machinist, now Western manager for Eastern company, desires to change; prefers Eastern territory; invites correspondence with particulars. Address "Excel," care AMERICAN MACHINIST.

MASSACHUSETTS.

Mechanical draftsman wishes position. Address Box 159, AMERICAN MACHINIST.

Mechanical draftsman and practical machinist, designer of tools, electrical, special and automatic machinery, desires responsible position. Box 167, AMERICAN MACHINIST.

NEW JERSEY.

Young man, 23, practical mechanic, wants position as toolmaker or draftsman. Box 181, AMERICAN MACHINIST.

Designer wants position; college graduate; 8 years' experience electrical and hoisting machinery. Box 200, AMERICAN MACHINIST.

NEW YORK.

Position wanted; technical graduate; 4 years foundry, shop and drafting room. Box 183, AMERICAN MACHINIST.

First-class mechanical draftsman wants to change position; New York, Brooklyn or vicinity preferred. O. N., Box 145, AM. M.

Position as superintendent or general foreman of machine shop; all-round, broad-gauge man; first-class reference. Box 204, AM. M.

Draftsman, mechanical; 5 years' experience, 2½ years on rock crushers and conveying machinery; references. Box 199, AM. M.

Position as toolroom foreman or assistant superintendent; well posted with up-to-date machinery, tools and methods. Box 185, A. M.

A1 mechanical draftsman, 6 years' experience, college graduate, capable to work out new ideas, wants to change; city preferred. Box 202, AMERICAN MACHINIST.

First-class foreman; experience small and medium interchangeable work; piece and premium systems; good organizer; accurate; up to date; references. Box 184, AM. M.

Millwright-machinist, qualified mechanic, prefer permanent position manufacturing plant, or would travel to install machinery and represent firm. A. H. N., care AM. M.

Position as foreman; 6 years' experience as such on interchangeable parts; can get results from inexperienced help; also first-class toolmaker. Box 182, AMERICAN MACHINIST.

Mechanic, 30; experience on tools, experimental work, special automatic machines, metal patterns, molding machines; capable to take charge; best references. Box 201, A. M.

Young man, 21, in drafting office; 2 years' experience at mechanical drafting (schooling) and 4 years at machinist's trade; willing to start with small salary; Cooper student; scientific department. Box 198, AM. M.

Mechanical engineer desires position; technical graduate with broad experience as chief draftsman, mechanical engineer, master mechanic and superintendent, in shop and mill

construction, maintenance and management; power plant design and installation, power transmission and in design and construction of machinery of various kinds; best of references. Box 197, AMERICAN MACHINIST.

Expert designer of machinery, large, universal experience, of exceptional capacity for originating; general machinery, power transmission, wood working, gas and gasoline engines, automatic and special machinery; correct estimating, systematic, modern; superintending erection; can bring customers, chief draftsman for 9 years, just resigned for good reasons, desires position with chance to assist in building up business. Box 186, A. M.

OHIO.

A practical machinist, of 14 years' experience as manager of general repair works, shop as well as office, is looking for a change. J. J., care AMERICAN MACHINIST.

Technical graduate, with 7 years' experience as chief draftsman and engineer with large mining machinery company, desires position with company in similar line. Box 188, AMERICAN MACHINIST.

Wanted—Position as chief or assistant draftsman; 11 years English and American shop and drafting room; graduate English university; West or South preferred. Address Box 156 AMERICAN MACHINIST.

Position as superintendent or foreman of forge shop; experienced and practical as cost-reducer in all classes of forging, stamping, bulldozer, steam hammer and hydraulic work. Box 187, AMERICAN MACHINIST.

PENNSYLVANIA.

Cost Clerk.—Up-to-date man, machine shop and foundry, cost, time, store and premium systems, desires change. Box 158, AM. M.

Position as foreman by an up-to-date, active wood patternmaker; 25 years' experience, with a thorough knowledge of drafting and blueprinting; age 42 years. Box 189, A. M.

Practical gear-cutting man wants position; 10 years' experience in gearing; can take charge gear room; can handle work and men advantageously; first-class references. Box 190, AMERICAN MACHINIST.

Mechanical engineer, 14 years' experience, familiar with heavy machine tools, hydraulic machinery, cranes, structural work, etc., desires change; can fill leading position. Address Box 152, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

ILLINOIS.

Patternmaker—A first-class wood pattern maker who thoroughly understands his business; only thoroughly competent sober, industrious, married men need apply; state wages expected. Address Box 191, AM. M.

MAINE.

Machinist that plays cornet, clarinet or trombone may learn of a steady job, at good pay, by writing Geo. E. Redman, 446 Main st., Rockland, Me.

MASSACHUSETTS.

Wanted—Tracer; must be accurate, quick and neat. Apply Box 193, AMER. MACH.

Wanted—Experienced man on Gleason bevel gear planers. Address, giving particulars, "Gears," AMERICAN MACHINIST.

Draftsman wanted immediately for small, alternating-current motors, switchboard appliances and special tool work; state references and full experience. Box 192, AM. M.

MICHIGAN.

Skilled mechanic with knowledge of electricity and experience in making small brass articles; work in perfecting electrical inventions and reducing to practical manufacturing form; permanent place and good prospects. Box 161, AMERICAN MACHINIST.

NEW JERSEY.

Patternmaker foreman; experienced on machinery patterns and also acquainted with molding machine practice; state age, salary and past experience. Address Box 169, A. M.

NEW YORK.

Wanted—Several experienced draftsmen for light interchangeable parts; location, central New York; state age, experience and salary expected. Address Box 194, AMER. MACH.

Superintendent—By large Eastern sewing machine company, for machine department, wherein milling machine work, jigs, tools and gages constitute production; $2,000. Box 203, AMERICAN MACHINIST.

A first-class designer of wood-working machinery, with knowledge of power transmission machinery; state experience, where formerly employed, age and salary expected. Answer P. A., care AMERICAN MACHINIST.

Foreman for small iron and brass foundry in Greater New York; familiar with medium and light engines, compressors and pump castings; state references, experience, age and salary expected. Box 205, AMER. MACH.

Three good detail draftsmen for permanent positions in New York city; must have had at least 2 years actual drawing-room experience; state age, salary expected and two business references. Box 163, AM. MACH.

Salesman wanted for territory west of Chicago, to introduce and sell "Sterling" hack-saw blades and frames to machine shops and hardware trade; no application will be entertained without references, and it is necessary to state age, experience and where last employed. Apply Diamond Saw & Stamping Works, Buffalo N. Y.

OHIO.

Wanted—Designers and detailers on heavy machine tool work; state age, experience and salary. Box 195, AMERICAN MACHINIST.

PENNSYLVANIA.

Wanted—First-class draftsman on mill construction and equipment; technical men preferred. Box 176, AMERICAN MACHINIST.

Our business is constantly increasing and we invite applications from machine and floor hands, accustomed to machine tool work. Standard Engineering Works, Ellwood City, Pa.

Wanted—A practical toolmaker, familiar with automatic screw machines, to set up and get results from these tools; one accustomed to getting out accurate, high-grade, interchangeable work. Address Westinghouse Electric & Mfg. Co., Employment Department, East Pittsburg, Pa.

WISCONSIN.

Wanted—A1 experienced salesman; one who has had experience in the crane line preferred. Apply or address Pawling & Harnischfeger, Milwaukee, Wis.

Foreman for gas engine shops of about 60 men; must know how to get out good work cheap; only a married man of good character, sober, steady and industrious need apply; a man having had gas engine experience preferred; but good mechanical judgment is required; state pay expected. Address Box 196, AMERICAN MACHINIST.

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Wilmarth & Morman Co., Grand Rapids, Mich.

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Blowers
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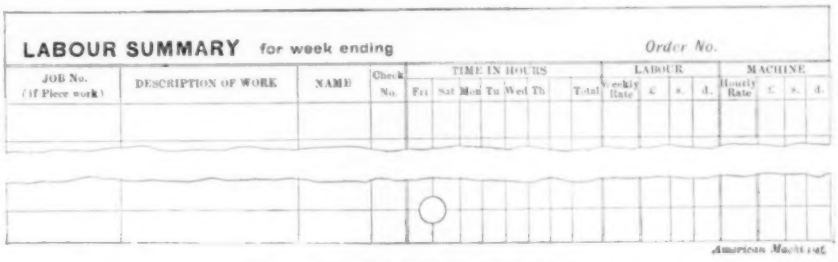
Cost Keeping in an English Machine Tool Works.

BY J. WILLIAM CHUBB.

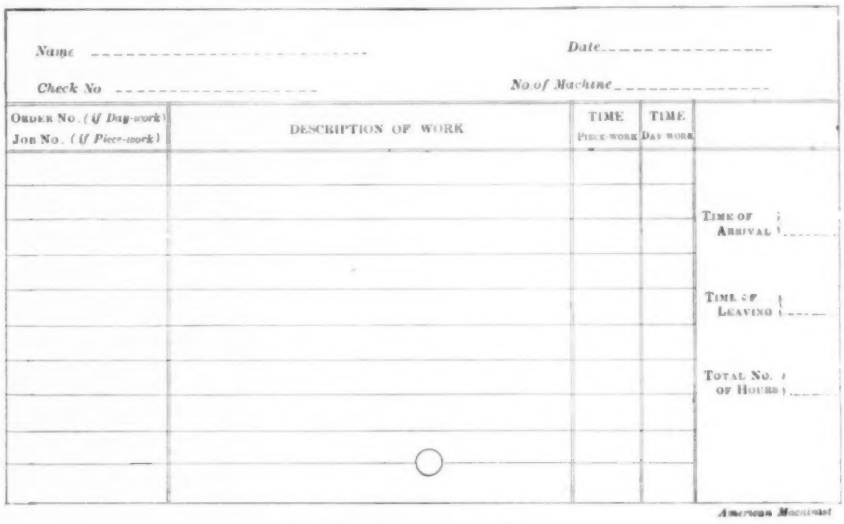
On the occasion of a recent visit, the writer found that Mr. Charles Taylor, Bartholomew street, Birmingham, had for some time been giving considerable attention to improvements in works organization, especially with regard to stores and cost-keeping arrangements. Very courteously Mr. Taylor, on request, supplied particulars and card samples, etc., on which the following account is based. The description is not given as indicating an ideal or a perfectly complete works organization, but rather as an outline of a fairly advanced stage of development in the introduction of accurate works cost-keeping into a machine tool factory. It may, moreover, be of interest as showing what an English firm has successfully put in practise, and finds adequate to its requirements, and it would be well if British manufacturers would come forward more readily with this kind of information for the common good. At present, tho many have discarded the old ideas of secrecy, they are yet afraid of risking expert criticism by making their methods public. Yet this criticism would be to their own advantage. Still descriptions of American systems are published much more frequently than is the case with English works.

During the development of the system the first condition was that changes of method should be made in such form and at such times as to cause the minimum of disturbance in the producing departments. In fact, the production did not merely remain stationary; it steadily increased from the date of alteration of the system. Mr. Taylor rightly contends that a determination not to allow the output of the works to suffer during the transition stage is too often forgotten by the ideal works organizer. The new methods have not necessitated any increase in the regular staff. Extra help had to be provided temporarily for such work as numbering the parts in the stores and making the registers of them, but apart from initial work of this sort, the original staff has proved sufficient and can now furnish the management with far more and far more accurate costs than formerly. The success achieved is in great measure due to Mr. Arnold Hawkes, who was called in for a time especially to organize the improvements.



FORM 2. WEEKLY LABOR SUMMARY.

About 130 hands are employed, and the products consist of certain standard repetition lines (machine tools of small and medium size, vises, chucks, etc.), a large number of variations on these standard lines and also a certain amount of repairs and a number of machines that have to be made specially throughout. The cost-keeping forms have been arranged to suit these requirements, forms 6, 7, 8 and 9 being original, and the remainder adapted from more or less general usage.



FORM 1. DAILY TIME SHEET.

OBTAINING AND SUMMARIZING THE TIME.

Form 1—Daily Time Sheet.—White paper, size 8x5 inches. Every man or boy on the pay-roll fills up one of these time sheets daily and hands it to the time-keeper as he leaves work. The same form is used both by day-work and piece-work men. Piece work will be mentioned later under the heading of Form 10. All the time sheets for one day are checked by the foreman first thing next day, and are then strung together in order of check numbers and compared with the time-keeper's book. Any discrepancies between the two are thus investigated and put right while the circumstances are fresh in the minds of the men concerned. The wages week ends on Thursday night, and wages are paid on Saturday.

Form 2—Weekly Labor Summary.—White paper, 8x5 inches. Dated with rubber stamp. After the daily batch of time sheets has been duly checked it passes to the cost office, where each item of time is transcribed on to a labor summary form, one of which is allotted to each order number for which time appears during the week. At the end of each week, when Thursday's time sheets have been transcribed, the week's batch of labor summaries is taken and the labor amounts are extended and totalled. From these totals the wages analysis for the week is obtained, and the slips are then filed away under their respective order numbers. It is worth mentioning here that altho the grand total in money of the total labor amounts taken from these slips will not agree exactly with the total wages paid (owing to all the extensions of wages on the labor summaries being calculated to the nearest farthing only), the same objection does not apply to the total hours. This, of course, agrees exactly with the total of all the men's time as shown in the wages book, and thus forms a valuable check on the transcribing. The now well-known method, by which each workman fills up a separate time card for every job on which he works during the day, would of course dispense with transcribing time. But, after due consideration, this method was thought to be unsuitable on account of the special nature of much of the work handled, which involves more frequent changing from one order number to another than in the case of repetition work. The weekly labor summary has also counteracting advantages for reference and criticism of costs, especially in a factory of moderate size, where it is useful to have the workmen's names in criticising the labor costs. A fresh batch of labor summaries is of course started each week.

ISSUE AND RECEIPT OF STOCK.

Form 3—Issued from Stores Slip.—Yellow paper, 5x3 inches, and *Form 4—Returned to Stores Slip.*—Blue paper, 5x3 inches. The stores department is divided into three main sections: (1) The purchased stores, containing bar iron and steel, black and bright screws, bolts and

nuts, sundries, such as lubricators, springs, taper pegs, etc., stampings, and general stores, such as oil, waste, leather belting, etc. (2) The castings stores, in which quantities of standard castings are always in stock, and thru which all special castings pass on their way to the machine shop. (3) The manufactured stores, which contain parts manufactured by the firm, and also the finished machines and products. The stocking of standard parts in varying stages of completion has received special attention; these parts are of course used in the construction either of standard or special machines to suit customers' requirements. Both in the purchased and manufactured stores, stores reference numbers are used for all standard articles. In the purchased stores, a separate numbered receptacle is provided for each variety and size of bolt, nut, screw, spring, lubricator, etc.; the larger articles being arranged in vertical racks, and the smaller in drawers. The storekeeper has a register containing all the numbers, with a full description of the article corresponding to each number. In the cost office is a duplicate of this register, containing in addition a record of the invoice prices at which the articles have been purchased.

In the manufactured stores, similar numbered receptacles are provided for all standard parts manufactured by the firm. In this case there is a letter prefixed to the numbers in order to distinguish them readily from the numbers of purchased articles, which consequently have no letter. The store-keeper has a register similar to the one in the purchased stores, and in the cost office is a card index containing a comparative costs card for each number (see Form 8, described later). These piece numbers are of course always quoted on stock orders and on the stores slips. These Forms 3 and 4 are written by the store-keepers during the day, whenever the issues or returns take place, and are sent to the cost office at the end of each day, where they are priced out during the following morning and filed away under their order numbers. Piece numbers are recognized as necessary for accurate and rapid cost-keeping, but apparently many British engineers still think the expense of providing a separate numbered receptacle for each article is unwarranted. Piece numbers give absolute identification, preventing all doubt in the mind of the cost clerk as to what the store-keeper has attempted to describe. Apart from this, nothing can be more rapid for pricing out the store slips than to have a piece number quoted by the store-keeper and then simply to refer to that number in a register to get the price.

ISSUED FROM STORES

Date _____ 190 *Issued to* _____ *Order No.* _____

Quantity	DESCRIPTION OF MATERIAL	Weight C.	Q.	L.	Rate	£	s.	d.

Issued by _____ *Storekeeper* 1345 24732

American Machinist

FORM 3. "ISSUED FROM STORES" SLIP.

RETURNED TO STORES

Date _____ 190 *Returned by* _____ *Order No.* _____

Quantity	DESCRIPTION OF MATERIAL	Weight C.	Q.	L.	Rate	£	s.	d.

Returned to _____ *Storekeeper* 1345 24732

American Machinist

FORM 4. "RETURNED TO STORES" SLIP.

STOCK RECEIVED

Date _____ 190 Made on Order No. _____

Quantity	Description	Piece No.	Factory	Cost

Inspector's Sig. _____ *Storekeeper's Sig.* _____

American Machinist

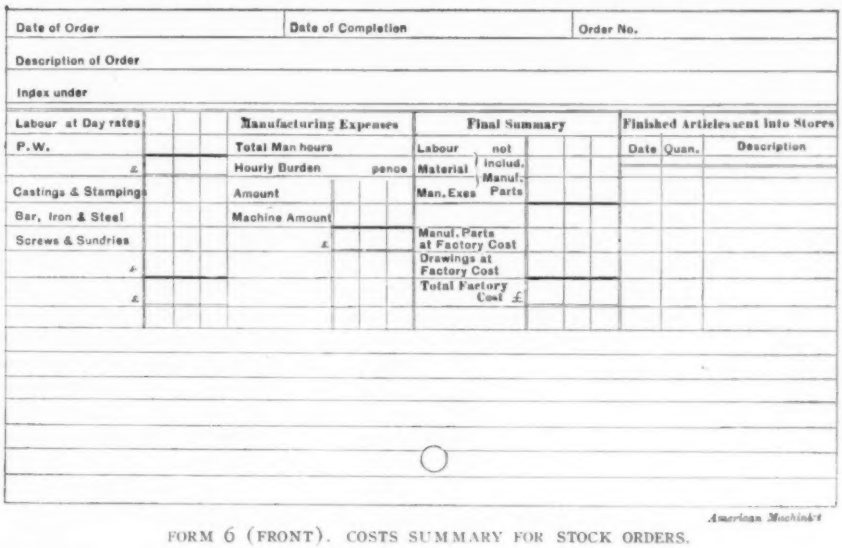
FORM 5. "STOCK RECEIVED" SLIP.

Form 5—Stock Received Slip.—Salmon paper, 5x3 inches. One of these slips is filled up by the store-keeper when receiving into the manufactured stores a batch of parts made to a stock order from the machine shops or smithy. The parts must not be put away into their numbered places until the inspector has examined them and signed the slip accompanying them. This inspection, being essential to the maintenance of a reputation for good work, is under the direct supervision of a member of the firm. After receiving the inspector's signature the slip is sent to the cost office, where it is filed for reference when summarizing the cost of the batch in question. A further reference to this will be found under the heading of Form 6. The money column headed Factory Cost cannot be filled up until the corresponding costs summary has been completed. The present intention is to make further use of the stock received slip by employing it as a medium for debiting the stock account in the nominal ledger.

SUMMARIZING COST FOR STOCK ORDERS.

Form 6—Costs Summary for Stock Orders.—Buff card, 8x5 inches, printed on both sides, but upside down relatively for ease in use. On completion of an order the weekly labor summaries which have been accumulating in the file are taken out and, having already been priced out as explained, the totals are posted on to the back of the costs summary, each week occupying one line. For this purpose there are fifteen lines, thus allowing for fifteen weeks. The stores slips, which have also been accumulating in a separate file, are taken out and sorted under the headings Castings and Stampings, etc., shown on the back at the foot of the card. It has not been found necessary so far to use any intermediate summary for material. The amounts from each issued from stores slip are totalled on the back of the last slip of each heading and these totals are posted on to the summary card on the line marked *debit*. The return to stores slips are treated in the same way, and the totals are entered on the line marked *credit*. The difference between the debit and credit amounts under each heading is carried to the front of the card. The space reserved for piece work is explained under the heading Form 10. The various totals obtained on the back of the card, having been carried to the front, are gradually condensed until the final summary and total factory cost are reached.

The column for *finished articles sent into stores* is used for noting the particulars from the stock received slips, previously mentioned as being signed by the inspector. If any parts have been spoiled during the progress of the batch, the quantity in this column will of course be less than the quantity shown at the top of the card under *description of order,* and the lesser quantity will be divided into the total factory cost to obtain the factory cost of each. The spoiled parts will have been sent into stores and credited to the order number in the ordinary way by means of a return to stores slip. The price at which such spoiled parts are credited depends on circumstances. In every case they will of course be entered as nearly as possible at their actual value.

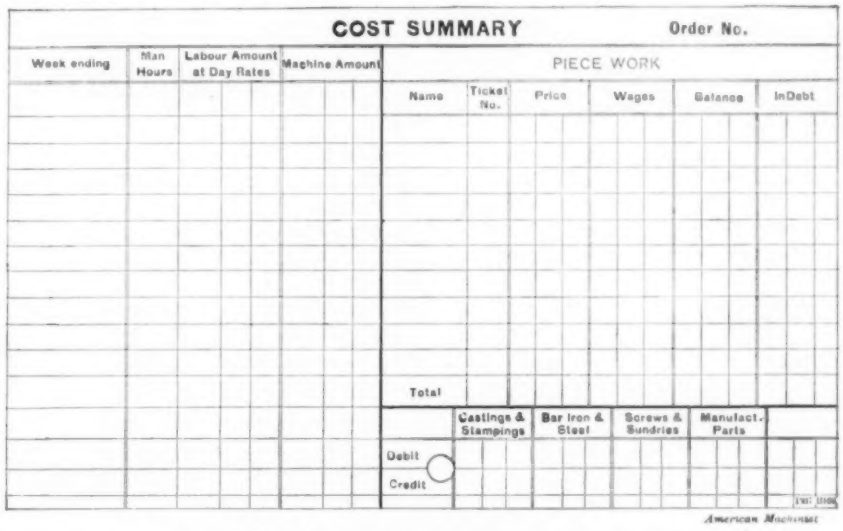


FORM 6 (FRONT). COSTS SUMMARY FOR STOCK ORDERS.

DISTRIBUTION OF EXPENSE.

It is necessary here to describe the method of distributing expenses—that is, allotting to each order a fair share of the indirect expenses of the establishment. In arriving at the total amounts per month or per annum to be distributed over productive orders by means of expense rates, a strong distinction is made between manufacturing and selling expenses. In cases where an expenditure is common to the two classes it is divided in as fair a proportion as can be assessed. Examples of this are rent, gas, water, insurance, office salaries, etc. The next important point is that manufacturing expenses are distributed on a time or per hour basis and selling expenses as a percentage on the factory cost.

The manufacturing expenses are distributed by two separate rates—first, the machine rate; second, the hourly burden. The machine rate is the medium for distributing expenses which are directly connected with, and vary with, different manufacturing processes, *e. g.,* depreciation, power, toolmakers' wages, etc. Every class of operation has its proper machine rate, fixed to correspond as nearly as possible with the actual cost of up-keep of the machine or equipment concerned. The hourly burden is the medium for distributing all manufacturing expenses not dealt with by the machine rates, *e. g.,* foremen's, store-keepers', time-keepers', and laborers' wages; oil, waste, etc.; part of drawing-office and pattern-shop wages; part of office salaries; part of rent, gas, water, etc. It is a rate of so much per hour which is charged to every hour of productive labor. No distinction is made between men and boys in applying either the machine rates or hourly burden. It will be seen from the costs summary that the hourly burden involves only one calculation for each order —that is, the multiplication of the total man-hours booked to the order by the hourly burden itself.



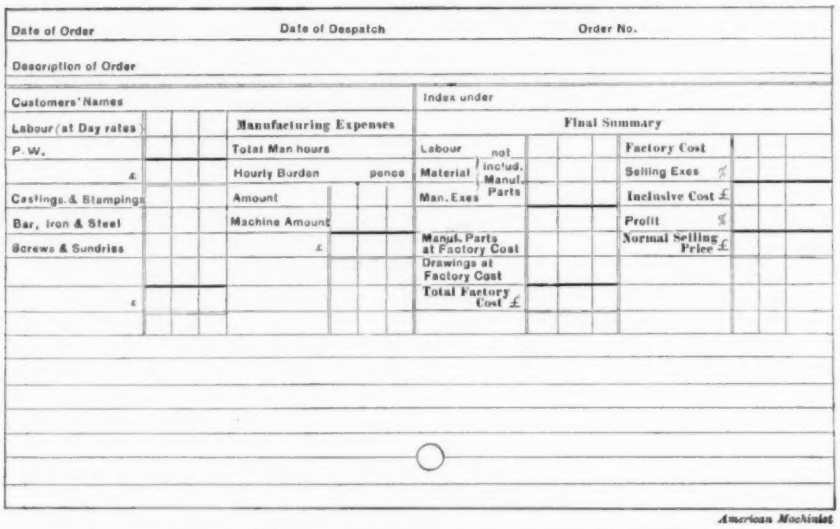
FORM 6 (BACK). COSTS SUMMARY FOR STOCK ORDERS.

The object of dividing the manufacturing expenses into two classes is to get a closer approach to accuracy in the factory costs of small jobbing orders, or batches of simple parts for stock—that is, parts which have had to go thru few processes. In the latter case it is often a question of manufacturing as against buying from another firm having better facilities in that particular direction. For instance, large quantities of screws of ordinary patterns and sizes are naturally purchased, but small quantities of special screws are manufactured by the firm. A dividing line has to be drawn between the two. The use of a per-hour basis instead of a percentage on wages for distributing manufacturing expenses is considered of the utmost importance. It has the effect (over and above the determining of factory costs) of emphasizing the time element on a job as against a consideration of the wages only. It tends to bring the employment of low-priced labor into its right place by showing that while a saving be effected in wages by giving a job to a low-priced man, the job may yet cost more because a larger number of man-hours are booked to it and therefore a larger share of manufacturing expenses. Equally important is the fact that under such conditions not only are the costs increased and consequently the profit is reduced, but also the output of the works is being kept down below the maximum possible. The right work for a low-priced man is held to be that which, on account of its simplicity, he can do as quickly, or very nearly as quickly, as a skilled man. Where the exact dividing line is, must be fixed by each firm, in accordance with the working out of their own expense rates work.

SUMMARIZING COSTS FOR CUSTOMERS' ORDERS.

Form 7—Costs Summary for Customers' Orders.—Salmon card, 8x5 inches, printed both sides. On the back this card is exactly the same as Form 6, and the main difference on the front is on the right-hand side. Here a calculation of the selling price from the factory cost takes the place of *finished articles sent into stores.* The proper share of selling expenses is allotted by adding a percentage of the factory cost, thus giving the inclusive cost. The importance of this figure is obvious in case selling prices have to be cut. This card is used only for customers' orders which involve non-standard work. All standard parts which can

possibly be utilized are drawn from the manufactured stores and appear on the costs summary as *manufactured parts at factory cost.* The making of the non-standard parts and also the assembly of the whole are booked to the customers' order number.

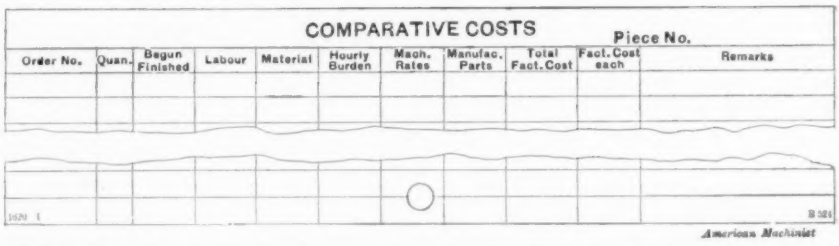


FORM 7 (FRONT). SUMMARY FOR CUSTOMERS' ORDERS.

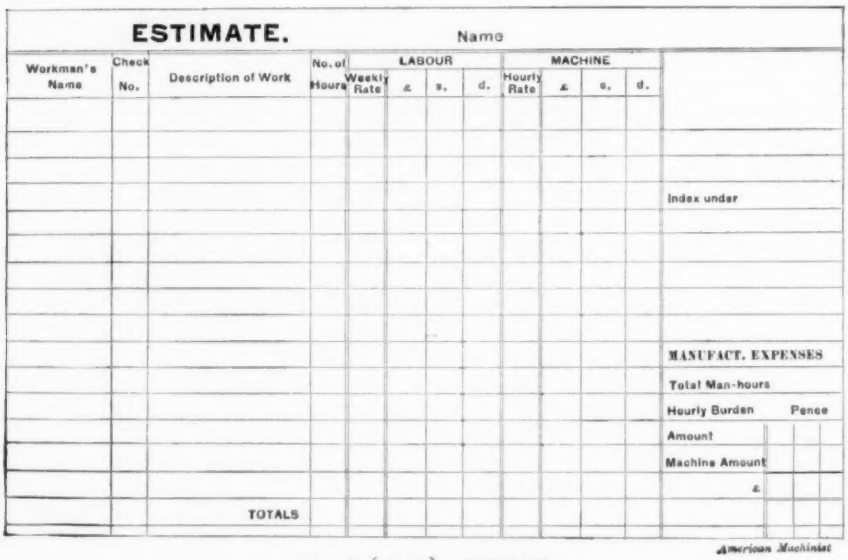
The method of charging manufactured parts to an order at factory cost is simple. They already carry their proper share of manufacturing expenses and have only to be added to the factory cost of the work actually done on that order.

COMPARATIVE COST RECORD.

Form 8—Comparative Costs of Standard Articles Manufactured by the Firm.—Fawn card, 8x5 inches, printed both sides, the rear side being in plain lines



FORM 8 (FRONT). COMPARATIVE COSTS OF STANDARD ARTICLE MANUFACTURED BY THE FIRM.



FORM 9 (BACK). ESTIMATE.

only and not shown. In the description of Forms 3 and 4 it has been explained that each manufactured part has a separate numbered receptacle in the stores, and that in the cost office is a card index with a comparative costs card corresponding to each number. The back of this card contains the stores reference number, or piece number, as it is usually called, with a full description of the part and a rough sketch when necessary. Records may also be made from time to time of alterations in methods of production that have caused reductions in cost. On the front each line is occupied with particulars of the cost of one batch of the article, these particulars being copied from the costs summary, the order number of which is referred to. One card thus carries a record of the cost of successive batches of the same article for several years, and provides a valuable means of constantly watching and reducing costs. Its uses for pricing parts daily on the stores issue slips and also at stock-taking are obvious. A cross index, in the form of a 5x3-inch card index alphabetically arranged, is used for the purpose of finding the piece number of an article from its description.

ESTIMATES.

Form 9—Estimate.—White card, 8x5 inches, printed on both sides. This card is used for calculating estimates on exactly the same basis as the costs. After what has been said in description of the costs summaries, etc., it will explain itself. The only difference is that the data of the time and material being more condensed, the whole of the particulars can be put on the card, and store slips or labor summaries are not required. These cards are filed according to customers' names, alphabetically. They are very valuable for comparison with the costs summaries when the work estimated for is actually executed.

PIECE WORK.

Form 10—Piece-Work Job Ticket.—Paper of different tints for each department, made up in duplicate carbon books. Size of ticket when torn out, 8x5 inches. This is filled up as far as and including the price and issued by the foreman. The job number consists of the order number with a sub-number, this composite number being used for piece work only. The foreman assigns the sub-numbers as he has occasion to give out piece-work jobs. Thus the first piece-work job on order No. 5000 would have for its job number $\frac{5,000}{1}$, the second job number $\frac{5,000}{2}$ and so on. The piece workers fill up daily time sheets (Form 1) in the same way as day workers, but they quote job numbers instead of order numbers and put the number of hours in the piece-work column. In transcribing the time on to the weekly labor summaries (Form 2) the job number is quoted in the first column.

The principle of dealing with piece work in the costs summary is that all time spent on piece work is collected thru the labor summaries, priced out, and manufacturing expenses are allocated to it just as if it were day work. It only remains to adjust the total labor amount on the costs summary by adding to it the piece-work balances earned. The method of doing this will be seen by referring to the back of the costs summary. The job number

comes into play in picking out the correct items of wages from the labor summaries with which to fill up the wages column. The heading P. W. (piece work) immediately under *Labor (at day rates)* on the front of the costs summary cards has a blank space after it, in which the word *balance* or *debt* is to be written, as the case may be. Then either an addition or a subtraction is performed accordingly, to give the labor amount in the final summary. The frequent making of adverse balances on piece work is of course not permitted, but the necessary headings are printed to allow of an occasional instance being properly treated. By the method described, piece work presents no difficulty in the distribution of manufacturing expenses on a per-hour basis.

The Telegraphone.

At a recent meeting of the Franklin Institute Dr. Z. B. Babbitt exhibited this instrument, which he characterized as "one of the great scientific discoveries of modern times." The discovery and invention of the instrument was made by a Danish engineer, Valdemar Poulsen, of Copenhagen, Denmark. It weighs about 15 pounds, and is of about the same dimensions as the phonograph and can be placed conveniently on a writing desk or a small table. The instrument exhibited had a time capacity—counting only the time when actually working—of 30 minutes, but it could be constructed to do two or three hours' work.

The following will enable the reader to form a general idea of the principle upon which the telegraphone operates:

"Conceive a piece of steel piano wire stretched between two points; take an ordinary electro-magnet and connect the coil of it in circuit with the secondary of an induction coil, the primary of which is in circuit with a microphone and battery. On speaking into the microphone, induced currents of electricity produce continuous variations in the field strength of the electro-magnet, and if we slide the electro-magnet along the steel wire the magnetic fluctuations of the electro-magnet affect the steel wire in the form of variable magnetic intensities. There have been impressed on the steel wire undulations of magnetization, a kind of writing that is permanent and which faithfully records the articulations of the voice. If the coils of the electro-magnet are connected with the telephone receiver, and the magnet is made to travel over the steel wire again, the telephone receiver repeats what was spoken into the microphone; or, in other words, acoustic vibrations, analogous to the original vibrations of the microphone, are reproduced in the telephone receiver. A special feature of the telegraphone in its different forms is the ease with which the record may be erased, it being only necessary to saturate the steel wire with magnetism by drawing it in front of a more powerful magnet so as to equalize the magnetic level differences created by a record, the wire then becoming as susceptible to further records as it was before."

"This machine has the ability of performing five different functions, which, briefly stated, are as follows: (1) It receives dictation; (2) it reproduces to the dictator; (3) it reproduces to one at a distant point, the machine being under control at that point; (4) it records conversations; (4) it records conversations between two persons over the commercial telephone lines without in any way interfering with the operation of those lines; (5) it records automatically, in the absence of the subscriber from the office, messages coming over the line during such absence, the machine being under the absolute automatic control from the ordinary performing function of the telephone line, the ringing of the bell starting the machine, the machine sending a signal over the line to the party talking, notifying him that the machine is running, the machine running a fixed length of time, sending another signal, then automatically stopping."

One type of the machine is used for the telephone distribution of news, market quotations, music, etc. The reproduction is audible to any number of persons, whether present in one place or scattered over a wide area.

2000

PIECE-WORK.

Workman's Name

Check No. *Date*

Job No.

Description of Work

Price

P. W. Ledger Folio

To filled in by workman — *Date started* / *Date finished*

Date passed for payment

Foreman's signature

Remarks

American Machinist

FORM 10. PIECE-WORK JOB TICKET.

Date **ESTIMATE.** Name

Description

Quantity	Description of Material	Weight C.	Q.	L.	Rate	£	s.	d.	Summary
									LABOUR
									MATERIAL } Not including
									MANUF. EXES } Manuf. Parts
									MANUF. PARTS at Factory Cost
									DRAWINGS " " "
									TOTAL FACTORY COST £
									SELLING EXES. %
									INCLUSIVE COST £
									PROFIT %
									NORMAL SELLING PRICE £

1307

American Machinist

FORM 9 (FRONT). ESTIMATE.

"The reproductions are true to the human voice either conversational or in song, and the day will come when every family will have records made at frequent intervals—from the child's first efforts at speech thru an entire life; and families will prize these records as they do photographs; national bureaus will be established for the preservation of records of speeches of our public men and women; correspondence will be carried on by the use of the disk machine in preference to the present methods. Many business transactions are carried on daily over the telephone, and the day is at hand when telegraphone records will be made of each and every transaction and filed away for reference. The telegraphone is destined to take the place largely of the present stenographer, and no business or professional man will think of writing his business letters, lectures or sermons. The loud-speaking device, which is nearly ready for the market, reproduces sufficiently loud to fill a lecture hall, and makes it not only possible, but probable, that the telegraphone will play an important part in the entertainment field."

This machine was first publicly exhibited at Paris in 1900 and has since been undergoing the developing process.

The Automatic Versus The Hand Turret Lathe.

BY PAUL WESLEY.

I hope most sincerely that after reading this article no one will think that I am prejudiced against the automatic, for I am not in the least. The automatic is all right on some classes of work, but, so far, it hasn't been a howling success on ours.

One day, about five years ago, we saw the superintendent coming up the aisle with a very pompous-looking individual, who was introduced as the traveling salesman for Blank & Blank, "who is going to sell us some automatic machines, as we have decided that a good deal of the work could be done cheaper on them; so if you will kindly show him around the room, he can see the work you are doing."

He was shown the piece represented by Fig. 1—which has a limit of accuracy of .003 inch, and the outside of which must run dead true with the hole—and the way we were rigged up to do it on the hand turrets, and after ten minutes he thought he knew more about the work than we did, and it was no use trying to tell him that we knew a little about it. He did deign to answer one question: We asked him how he intended to hold the piece when he finished it. "Why, that is very simple," he said; "we shall hold it in one of our dust-proof chucks." We asked him if he expected to get the outside to run true with the hole in that way. "Why, certainly," said he, "we build a chuck which will not get out of true."

After waiting a while we were informed that we would shortly receive six machines, which would produce 400 pieces per day and require only one man to operate them. Before they came their builders sent word that they would like a thousand castings or so to experiment on, and soon after along came a sample which they had made, and which on inspection ran fairly true; but we knew well enough that there was no chuck ever built which would run true after a month's usage. Finally the machines arrived, and when the firm had been notified that the machines were set up and ready to run, they sent a man on to start them up.

EARLY EXPERIENCES WITH THE AUTOMATICS.

They were real nice, pretty machines, and had some nice, slender parts, which might well have been heavier, and when the tools were unpacked we saw some which were fearfully and wonderfully made, one tool-holder having tools which performed five operations at once. The operator broke in a man on them, staying a week for the purpose, and I guess that he was glad when the week was up. Owing to the fact that we use a very hard grade of iron, and one varying in hardness, too, the automatics labored at a disadvantage; when they struck an extra hard casting they usually didn't stop until something broke.

From the very first week fully 10 per cent. of the finished work ran out and had to be thrown away, and the percentage of bad work steadily increased, and by the time three months had passed about 40 per cent. was bad, so we were compelled to make the finished work above size and refinish on a hand machine. We did that for a while longer, and then we got disgusted and changed the automatics over into roughing machines, simply doing the drilling and reaming on them, and turning off the head and doing the finishing on the hand machines, as we had always done. I will now compare the way in which the hand machines and the automatics were rigged up, and readers can judge for themselves which is the more practical way of doing the work.

METHOD OF HANDLING THE WORK ON HAND MACHINES.

To make this piece on the hand machine we rig up as follows:

The casting is grasped by the small end in a two-jawed chuck, there being about ⅛ inch between shoulder *B*, Fig. 1, and the chuck. There are five tools in the turret and a front and back tool on the cross-slide. The tools are used as follows: 1. Centering drill. 2. Drill. While drilling the operator runs up the front block

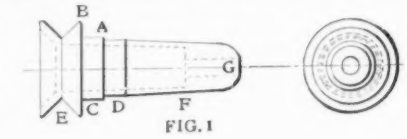


FIG. 1

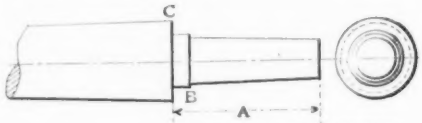


FIG. 2 *American Machinist*

AN AWKWARD TURRET MACHINE JOB.

on the cross-slide and grooves the head *E* and then runs up the back block containing a forming tool which rough forms *E*. 3. Bottoming drill which squares the bottom of the hole. 4. Holder containing two tools, one of which squares and the other countersinks the end. 5. Reamer. The castings after going thru this process are taken to the reaming stand and reamed to size, being grasped with a pair of pipe tongs and pushed on to the reamer by a lever tailstock.

From there they go to the finishing machines which are rigged up in this manner: The spindle in the headstock has a taper hole into which is driven a plug like Fig. 2, *A* projecting about 2½ inches. This plug is hardened and ground all over and driven into the spindle and then *A* is ground by a portable grinding attachment, *B* to fit the hole in the collar and the taper to fit the hole in the work. This grinding attachment we built ourselves and it is driven by a small countershaft which can be put up over each machine. The thread on the spindle nose is protected by a collar which screws on. This collar has a hole which fits *B* on the taper plug and brings up against shoulder *C*, thus holding the plug from coming out. The operator has a gage which he places against this collar and drives the piece on to the taper plug up to it. This brings all the pieces alike for length. The taper in the hole is ½ inch to the foot and the piece is driven on to the plug 3-32 inch. There are five tools in the turret and a front and back block containing tools on the cross-slide.

The tools are used in this order: 1. Turning tool, which roughs out as far as shoulder *A*, Fig. 1. 2. Turning tool, which roughs out *C* and squares shoulder *B*. 3. Centering drill. 4. Forming tool, which roughs out the round end. 5. Front block on cross-slide, which contains three tools which finish shoulder *B*, cut *C* and *D* to size, and form the taper. 6. Back block containing forming tool, forming and bringing to size *E*. 7. Forming tool in turret which finishes the round end.

We do not drill the small hole *G* in the turret lathe, as we can drill it cheaper in a speed lathe which is rigged up specially for that work. These pieces when finished and tried on a test plug run so true that with a block placed close to the work there is no wink perceptible to the eye. No more than 2 per cent. of a day's work from the hand machines is bad.

METHOD OF HANDLING THE WORK IN AUTOMATICS.

Now this is the way the builders rigged up their automatics, refusing to accept any suggestions from us: They had three machines to make the piece, each three machines turning out 200 pieces per day. The first machine grasped the casting by the small end and performed the same operations that our roughing hand machine does except that they didn't groove the head at all on this machine. The second machine grasped the piece by the head *E*. The first tool in the turret controlled by a former on the cross-slide roughed out the taper, rounded the end and centered it. The small hole *G* was drilled next and while being drilled a tool in the back block on the cross-slide roughed down the shoulder *B*. The last tool in the turret was a combination which finished the taper, rounded the end, and finished *C* and *D* and shoulder *B*. The third machine grasped the piece in a collet on the finished end *F* and the first tool reamed the hole and finished the countersink. During this reaming a forming tool in the front block rough formed *E*. Next another reamer gave the final reaming and squared the end. During this last reaming a forming tool in the back block finished *E*. There were six machines making 400 pieces per day. The finishing machines were equipped with a fan which blew the dust from the work.

COMPARISON OF LABOR COSTS AND PRODUCT.

Some comparisons of the cost of making these pieces may be of interest. The labor cost alone on 200 pieces is shown in the accompanying table.

Now this figures out very nicely on paper, but that is as far as it goes. If the

machines had worked properly they would have effected quite a saving in the cost of producing this work, but as 10 per cent. of the product was bad from the start and this percentage steadily increased until it resulted in the changing of the machines into roughers, they have not earned enough

Roughing	$1.33
Finishing	1.70
Reaming	.13
Drilling	.20
Cost for 200 on hand machines	$3.36
Cost for 200 on automatics	2.20

to pay for their increased cost over hand machines, and the cost of changing over.

We have two other automatics from a different firm which were rigged up practically the same as our hand machines under our directions, altho they didn't want to use our ideas. It seems very funny to me that the builders of these automatics always think that they know more about what tools are needed for the machines than the people who have done the work for years. These new machines are heavy enough, weighing 5,000 pounds each, and compared with the work they seem large but they are not a bit too heavy. The great fault with most automatic machinery is that it isn't built heavy enough for the work it is intended to do

One man runs these two machines and the cost for 200 pieces is $2.00—about 5 per cent. of the 200 being bad. These last two machines do very well, altho the work is not as good as that turned off on the hand machines. Compared with our hand machines at $3.36 per 200 pieces there is a saving in labor cost of $1.36 per 200 pieces in favor of the automatics, but as repairs and fixtures, which are not included in the above costs, cost about twice as much on the automatic—and taking into consideration that the work turned off is not as good—there is not so much difference after all.

Machinery and the Law of "Diminishing Returns."

Volumes might be written relating to the influence that machinery has exerted in this respect—machines whose construction results in processes that parallel the work of the human brain and the human hand. Modern science shows that such machinery does not have the effect outlined by Dr. Smith in his story of the pin machine. To these machines we apply steam, compressed air, water, electricity. All the great forces of nature are brought into play, and thru the ingenious contrivances of man supply the forces by which the law of diminishing returns is modified. In all directions this influence is observed; in a thousand directions we see the doing away with the rule of thumb and the application of distinct, positive scientific principles. The factory itself is a scientific structure, involving the highest mathematical skill. Thru these things and the application of new principles in agriculture science overcomes the influence of the seasons by preserving products, by equalizing prices and by all the other means by which the world is brought into closer contact, one nation or people with another.—*Carroll D. Wright before the A. A. A. S.*

Locating the Decimal Point With the Slide Rule.

BY RUPERT A. GREENE.

Multiplication.

A = number of digits in first factor.
b = number of digits in second factor.
c = number of digits in third factor.
d = number of digits in fourth factor, etc.
n = number of times 10 point is passed.
N = number of digits in product.

$$N = A + (b - 1) + (c - 1) + (d - 1) + n \qquad (a)$$

Division.

N_1 = number of digits in dividend.
N_2 = number of digits in divisor.
N = number of digits in quotient.

There are two cases:

Case I—When dividing the dividend by the divisor if it is possible to read the quotiont without pasing the 10 point—

$$N = (N_1 - N_2) + 1 \qquad (b)$$

Case II—When dividing the dividend by the divisor if it is *not* posible to read the quotient without passing the 10 point—

$$N = N_1 - N_2 \qquad (c)$$

EXAMPLES.

(1) $2 \times 2 = 4$. . . . . Apply (a)
$A + (b-1) + n = N.$
$1 + (1-1) + 0 = 1.$ Which means that there is one figure or digit to the left of the decimal point in the result.

(2) $890 \times 750 = 667{,}500$ . . . Apply (a)
$A + (b-1) + n = N.$
$3 + (3-1) + 1 = 6$ figures to the left of the decimal point.

(3) $.002 \times .0006 = .0000012$ . . Apply (a)
$A + (b-1) + n = N.$
$\bar{2} + (\bar{3} + \bar{1}) + 1 = \bar{5}.$ Which means that there are five ciphers between the decimal point and the first figure on the right.

(4) $800 \div 40 = 20.$ Case I . . Apply (b)
$N_1 - N_2 + 1 = N.$
$3 - 2 + 1 = 2$ figures to the left of point.

(5) $1200 \div 4 = 300.$ Case II. . Apply (c)
$N_1 - N_2 = N.$
$4 - 1 = 3.$

(6) $.008 \div .02 = .4.$ Case I . . Apply (b)
$(N_1 - N_2) + 1 = N.$
$(\bar{2} - \bar{1}) + 1 = 0$ figures to the left of the point.

(7) $.002 \div .04 = .05.$ Case II . Apply (c)
$N_1 - N_2 = N.$
$\bar{2} - \bar{1} = \bar{1} = 1$ cipher between point and first figure on right of point.

In a longer example, thus:

$$\frac{2 \times 8 \times 9 \times .06 \times 2}{4 \times 3 \times 6 \times 5 \times .02} = \frac{17.28}{7.2} = 2.4.$$

Performing the denominator operations first,

$A + (b-1) + (c-1) + (d-1) + (c-1) + n = N.$
$1 + 0 + 0 + 0 + (\bar{1} + \bar{1}) + 2 = 1.$

Now, performing the numerator operations, it will be seen that the last setting will be ready to be divided by the denominator 7.2, whereas if the numerator operations were performed first we would have an extra setting when we came to divide.

For the numerator:

$A + (b-1) + (c-1) + (d-1) + (c-1) + n = N.$
$1 + 0 + 0 + 0 + (\bar{1} + \bar{1}) + 3 = 2.$

Dividing:

$17.28 \div 7.2 = 2.4.$
$N_1 - N_2 = N.$
$2 - 1 = 1.$

The foregoing description which, perhaps, may not look very simple, is actually as simple, with a little practise, as the ordinary method of counting the figures when working without the rule and, in fact, I use it considerably in preference to the ordinary method when working without the slide rule, simply remembering the number of times the 10 point would be passed with the rule.

It is well, especially at first, to set the formulas down and then place the figures over them, as has been done above, but with a little practise this will not be necessary. The formulas are easily remembered and they put the matter in a systematic form which soon becomes habitual.

We understand that Mr. J. F. Brooks, who is in charge of the engineering laboratories at the Leicester Technical School, is carrying out research work upon the relations between the forces reacting upon the tool and cutting angle and the form of the turnings given off. A special tool rest has been constructed, enabling the forces to be obtained in three directions at right angles, representing the axis of co-ordinates, and, in conjunction with microphones, the exact loads are easily determined. A microscope and camera are attached to the tool rest, enabling permanent records of the cutting action to be made while the tool is actually at work.—*The Engineer.*

The Bryan Manufacturing Company, Bryan, Ohio, the only concern in the world manufacturing wheelbarrows exclusively, having been established in that business thirty-eight years, reports that its export sales to Cuba have trebled in the past eighteen months To Argentina double the number of wheelbarrows were shipped last year as compared with 1903. The company is looking for big orders when the Panama Canal work gets under way, but if the methods of the New York subway construction are followed there may be some disappointment.

The New Plant of the Vereinigte Maschinenfabrik Augsburg und Maschinenbaugesellschaft Nurnberg, A. G.

BY FRANK C. PERKINS.

One of the finest and most up-to-date manufacturing plants in all Germany has recently been completed at Nurnberg by the builders of the famous Nurnberg engines of the internal combustion type for utilizing waste gases from blast furnaces and coke retorts, as well as producer, illuminating and natural gas. The Nurnberg gas engine is constructed in the United States by the Allis-Chalmers Company, of Milwaukee, who are the American representatives of the Vereinigte Maschinenfabrik Augsburg und Maschinenbaugesellschaft Nurnberg A. G. The latter firm has besides the new plant recently constructed at Nurnberg three works at Augsburg and Gustavesburg employing more than 10,000 workmen. The new plant just completed at Nurnberg has been under construction for several years under the direction of Baurat Dr.-Ing. Reppel. The plant is located 1.5 kilometers from the city, where a workmen's colony has been established and high-grade workmen's dwellings have been erected.

All of the shops are largely operated by electric power and are electrically lighted by 700 arc lamps, together with more than 3,000 incandescent lamps, the heating being accomplished by using the exhaust steam from the power-house, together with that from a low-pressure steam heating boiler plant having 129 square meters of boiler heating surface. All of the condensed water from the heating plant is returned by underground pipes to the power-house feed-water hot-well. There is a total of forty-two electrically driven hoists and traveling cranes in the entire plant, most of which are of the three-motor direct-current driven type.

The wood-working shops are equipped with eighty-one machines electrically driven in groups. There are seven groups of wood-working machine tools operated by direct-current motors varying in capacity from 8 to 50 horse-power each, the shafting of each group being driven at a speed of 500 revolutions per minute. The saw-dust and shavings are carried thru piping to the boiler-house, the main pipe being 180 meters long and 500 millimeters in diameter, the blower being operated by 8 horse-power electric motors. The exhaust plant has a capacity of 25 cubic meters of air per second, the total air of the shop consisting of 20,000 cubic meters, being renewed every 13 or 14 minutes.

The machine shops are equipped with electrically driven tools operated in groups in the galleries and elsewhere where small machines are utilized, direct-connected high-power motors being employed for driving individual machines of large capacity. The machine shop and erecting shop for high power gas engines, as well as high power vertical steam engines are equipped with large lathes, planers and boring machines, all of which are motor driven by special machines. Fig. 1 shows a large gas engine of the Nurnberg type constructed for the rolling mill for the Burbache Hutte, of Lorraine, constructed at this plant, and Fig. 2 shows a large electrically driven boring, drilling and milling machine operating on an engine bed plate.

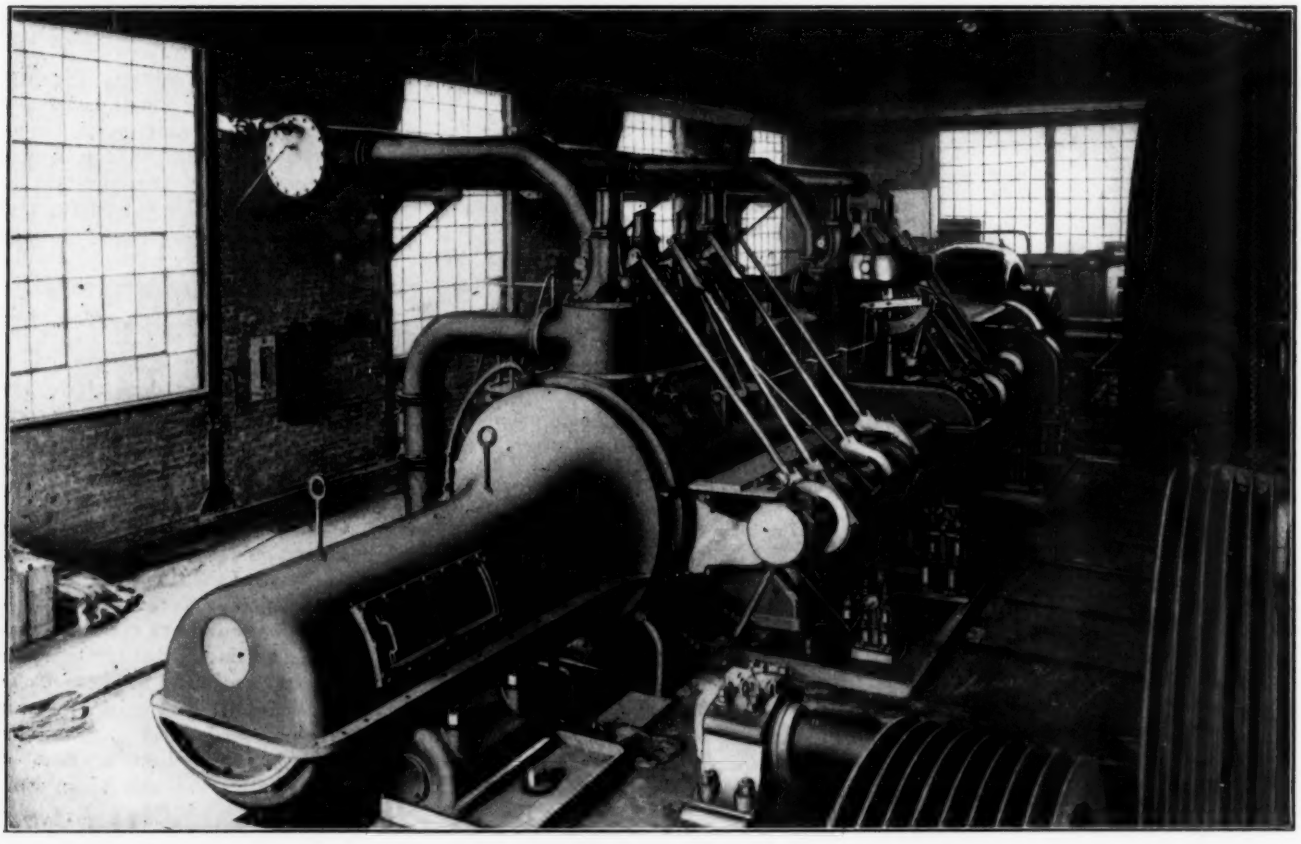


FIG. 1. GAS ENGINE FOR ROLLING MILL WORK.

A Report on Power Presses.

The *United States Trade Reports*, of Cincinnati, sends one of its proposed "write-ups" to the Lucas Machine Tool Company, of Cleveland. Its able editor has had the usual careful examination made by his corps of experts, who have traveled all over the country, made numerous tests and talked with numerous other experts about the presses made by the L. M. T. Co. without, however, finding out just what the press is for or what kind of a press it is. The L. M. T. Co. send us the "report" with a letter in which they say:

"You will see by the enclosed that our old friend in Cincinnati has broken out again and his former experience in mixing up seed drills and twist drills has evidently made him cautious, as he simply says that our 'power presses possess many points of value and merit' and lets it go at that.

"We had supposed, or at least hoped, that everybody knew that our press is not the conventional form of power press, but a special form designed to give pressure

for forcing arbors, driving pins and bushings to place, forcing gears on to shafts, broaching, etc., all of which our Cincinnati friend carefully refrains from mentioning and prudently advises his readers (?) to address us direct for particulars.

"You will note also that the price of extra copies remains about the same as before."

Perhaps Mr. Geo. C. Carter, who figures as the editor of the interesting publication referred to above, might accept a suggestion from us to the effect that before sending out a lot of rot about a machine made by some concern he wishes to victimize he look over the advertising pages of the AMERICAN MACHINIST, and if he finds the name of his intended victim there withhold his hand and save his postage. They all know the game and are too intelligent to be caught by it. Of course there are a lot more who read this journal but do not advertise in it, and chances would have to be taken on them, but by cutting out the advertisers considerable postage might be saved.

Men employed in the British dockyards when specially recommended by their officers have been allowed to remain until sixty-five. Under a recent order all over sixty-five must leave by the end of January, and the remainder over sixty by the end of March.

Notes on Cranes—Hydraulic Cranes.

BY A. D. WILLIAMS.

Previous to the advent of the electric crane, there were a number of situations in which power-driven cranes were undesirable, owing to their complicated mechanism and liability to hang up at critical moments. In such situations the hydraulic crane found a field, and altho it had its disadvantages, in the limited area served and was prone to leak, its simplicity and reliability overbalanced all other considerations. Such cranes require very little attention, chiefly repacking the glands and oiling and keeping the valves and pipe joints tight. Failures are infrequent, as the leakage gives ample warning of impending trouble and such hang-ups as do occur are in most cases chargeable to the water supply. The cylinders are preferably single-acting, the double-acting piston being used only where it is impracticable to install simple plungers. The water pressures used run from 300 to 8,000 pounds per square inch. The higher pressures are more economical for heavy work, but for ordinary service conditions where moderate weights are handled, the size of the plunger is often governed by its stability as a column and the higher pressures are not of advantage. In most steel plants the pressure service is 500 pounds per square inch, which for general work has been found satisfactory. Higher pressures for intermittent use are provided by an intensifier.

Both jib and travelling cranes are used and often the hoist only is hydraulic, the other motions being operated by hand, power, or electric motors as convenient. To do away with the walking pipes, which limit the service area, a motor-driven pressure pump and a water tank have been installed on the crane.

TYPES OF HYDRAULIC CRANES.

The simplest hydraulic crane consists of a goose-necked plunger from which the load can be slung and the cylinder, which serves as a post and pintle bearing. The slewing is done by hand. For heavier loads a top pintle and a jib are provided. For still heavier work, or to gain speed on light work, chain multiplying gear is used for the hoist and sometimes for the rack. Slewing is done by two opposing single-acting plungers moving a rack meshing with a pinion keyed to the pintle. The above are all of the ordinary high jib type.

Bessemer ladle cranes are usually of the low jib type. The ladle is carried on trunnions by a carriage which can be racked in or out by a double-acting hydraulic cylinder. The jib is supported by a carriage on the mast, the lower wheels of which on the face of the mast take compression while the upper wheels on the back take

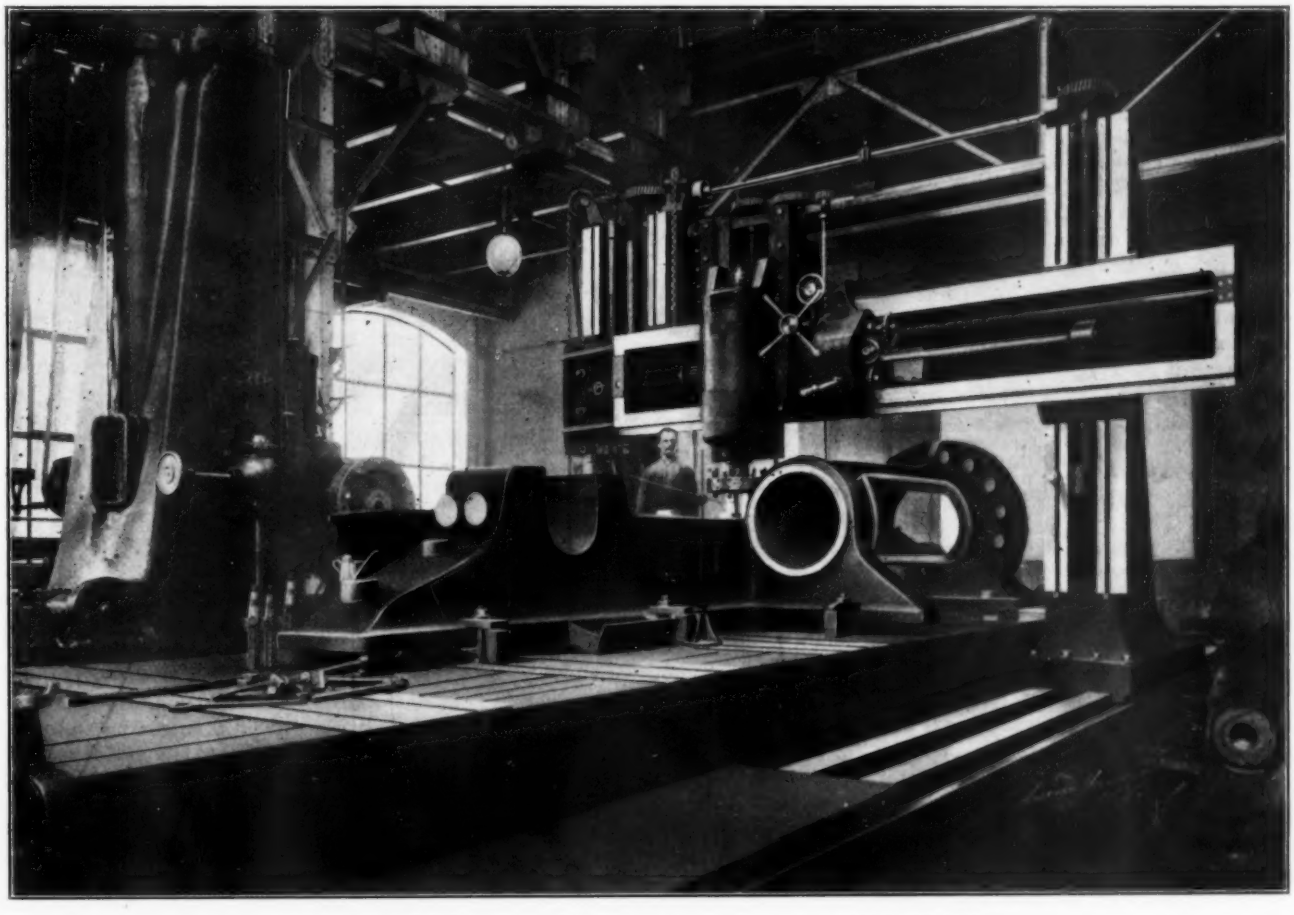


FIG. 2. ELECTRICALLY DRIVEN BORING, DRILLING AND MILLING MACHINE.

the tension of the tie-bars supporting the jib. The lifting cylinder is placed back of the mast, its plunger acting directly on the crosshead to which the tie-bars and upper carriage wheels are attached. Slewing is performed by two opposing plungers acting preferably on the lower pintle thru a rack and pinion. The upper pintle bearing is adjustable to allow leveling up. The water spindle can be at either the top or bottom pintle, and consists of a cylindrical casting containing three cored holes. It turns with the crane, and encircling it are three rings to which the water is led from the controlling valves. These rings are provided with glands, and cover the openings to the holes cored in the spindle. From the spindle one pipe leads to the hoist cylinder, and two with telescopic packed joints lead to the racking cylinder.

On travelers the bridge is usually traversed by three cylinder engines of Brotherhood type, and the trolley can be racked in the same way or by means of chains and multiplying gear driven by a double-acting cylinder. This last method can be used for the hoist also, the Brotherhood engines actuating a chain drum, or a direct-acting cylinder may be used. The water is conveyed to the crane by a walking pipe, which is an enlarged edition of a double or triple swing gas burner bracket. Of course it does not stay tight at the joints for all time and there is a certain amount of drip that may not be pleasant.

ELECTRO-HYDRAULIC CRANES.

To get rid of walking pipes and extend the area served electro-hydraulic cranes can be used, in which the bridge and trolley travel are effected by electric motors. An electric driven pressure pump and a waste water tank are installed upon the trolley, the scheme of operation being similar to hydraulic wheel presses found in many shops. This type of crane can be specially rigged up to strip ingots, and has many advantages over the ordinary type of hydraulic stripper. The operator travels with the trolley.

ELECTRIC INGOT STRIPPERS.

All-electric ingot strippers are in use and have some advantages, among which are speed and radius of action. They can be made single or duplex. The duplex machines handle two ingot molds at once and are particularly suited for Bessemer plants turning out ingots in pairs on cars which vary but little in size. The single stripper can be adapted to handle a larger range of sizes and is better adapted for open hearth, serving plate and slabbing mills. Those first built had a single screw, threaded right hand at one end and left hand at the other. The upper nut extended downward and carried the ram which was lowered on top of the ingot, the lower nut carrying a pair of links which engaged lugs on each side of the mold. This apparatus was carried by a crosshead whose ends were guided and prevented from turning by a frame extending down from the trolley. The crosshead was raised and lowered by power to clear the ingot and drop the mold. The screw was turned by a vertical square shaft which it telescoped. The twisting movement on the crosshead was considerable and required very rigid guides. The electric stripper can be improved by using two screws in tension working together in place of a single screw, each screw having a right and left thread, and being turned by a vertical square shaft. This arrangement permits each screw to counteract the turning movement in the crosshead due to the other. Guides are necessary to spot the holding-down ram on top of the ingot. The electric stripper does not stall when it strikes a sticker, as does the hydraulic machine. It either strips the ingot, pulls the top of the mold or the lugs off, or blows the fuse. It may break down, but it does not stall.

A Four-Cylinder, Three-Stage Air Compressor.

The cuts show the essential features of an interesting air compressor built by Reavell & Co., Ltd., Ipswich, England, and described in a recent issue of *The Mechanical Engineer*, London. The actual dimensions of the compressor are not stated, but the crank is assumed to be allowed to work up to 500 revolutions per minute, so that it may be called a small compressor. The crankshaft is driven by any suitable means and all the pistons are driven by the single crank, the intake or low-pressure pistons of cylinders A and B, opposite each other, being operated by the connecting rods A_1 and B_1, while the pistons or plungers of cylinders C and D, in another plane, are connected by a "Scotch" yoke with slippers upon the one common crank-pin. The air as first compressed in cylinders A and B passes by

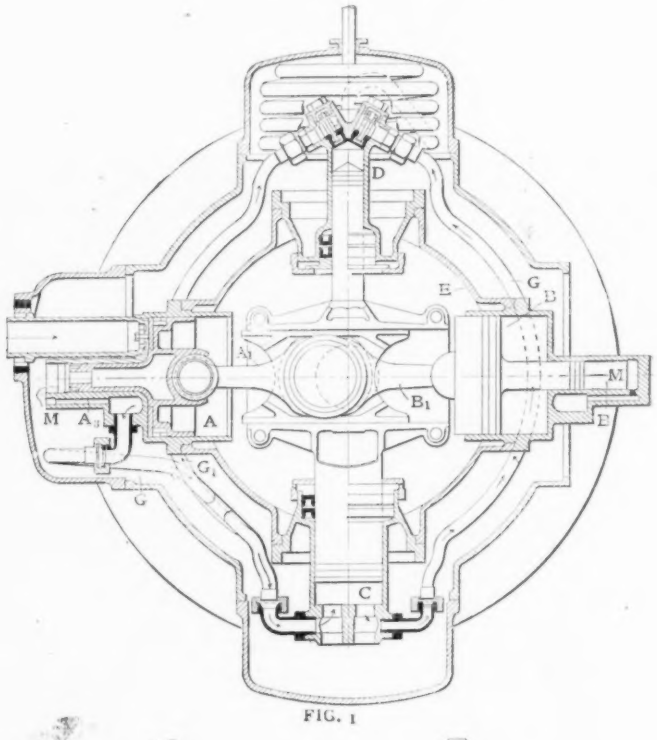


FIG. 1

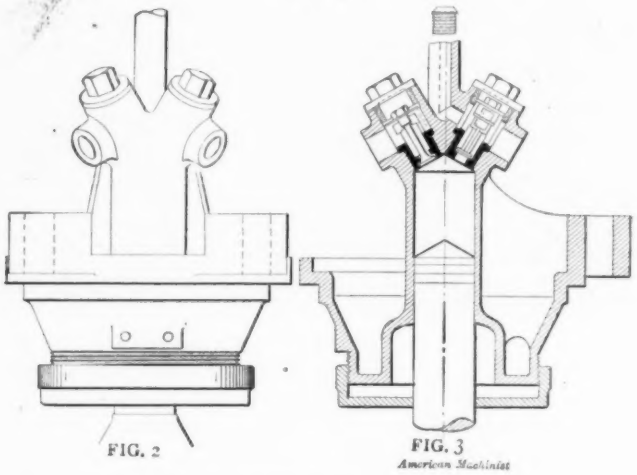


FIG. 2

FIG. 3

American Machinist

FOUR-CYLINDER, THREE-STAGE AIR COMPRESSOR.

pipes G to cylinder C and then by pipes G_1, behind those marked G, to cylinder D and is delivered thru a cooling coil above. The pipe G and G_1 pass thru an annular water-jacket in the frame E. Each cylinder is also mostly surrounded by cooling water. An interesting feature of the compressor is the arrangement for preventing lost motion by keeping the pistons always pressing against the crank-pin. The first-stage cylinders A and B are each combined with a small outside pilot cylinder, A_3 and B_3. A space M at the back of each pilot piston or plunger is connected to the first stage air delivery pipes, thus maintaining a back pressure against the crank-pin. Constant pressure and silent working of the third and fourth plunger pistons are guaranteed as they always work against the pressure of the previous compression. Lubrication is secured by the splashing in the central chamber or enclosed part of the frame.

Waiting for Patents to Expire.

A certain firm of loom buildlers, having learned that prospective customers were withholding orders in the hope that when certain patents expire in the near future prices will be forced down by competitors, has sent out a circular which rather convincingly speaks of the futility of waiting. The considerations urged apply to various other lines of machine building besides that of looms. The circular says:

"It is true that we did take out several patents in 1891 on the earlier devices in this line, but the fact that we ourselves did not place Northrop looms in the mills until 1895 shows that these earlier devices were not sufficiently developed to meet with our own approval for trade use in large quantity. They did not contain the advantages of the trade mechanisms, and they would not be acceptable in view of the advantages of the more recent devices. The ideas presented in our first trade looms were covered by patents taken out near the time of sale, which will not expire for seven years or more. Since that period, we have taken out hundreds and hundreds of other patents on newer improvements. The looms sold in 1895 were built over to make them satisfactory; but they do not compare with the looms which we sell to-day. Those who might be able to build our loom of 1895, at the lapse of seven or more years would not only have to compete with our present improvements but also with the improvements which we shall undoubtedly introduce during the next seven years. If they would be willing to sell a duplicate of our early loom at cost price, with no profit whatever, we should easily prove that our present loom is well worth the difference between such figures and our asking price. There is not one single group of mechanism on our loom of to-day which is not fully covered by patents having from ten to seventeen years of life.

"There were many mills who thought they would wait when we asked them to buy in 1895. Every one of the mills that did buy has proved the value of their purchase by giving us large orders for more looms. We could make a strong argument by referring to the present conditions of many mills that did not follow such a course, but we are content to let the possible purchaser make his own comparisons."

In this connection we note that recently it appeared that an English manufacturing concern that put in a new equipment of machinery after having been repeatedly urged to do so without success, found that if they had put in the new equipment three years earlier, when it was first brought to their attention, they would in the three years have saved its entire cost and been much better prepared to meet competition which was becoming bothersome.

The Measurement of Vacuum.

The following is from a paper by C. Turnbull, read before the Newcastle Local Section of the Institution (British) of Electrical Engineers:

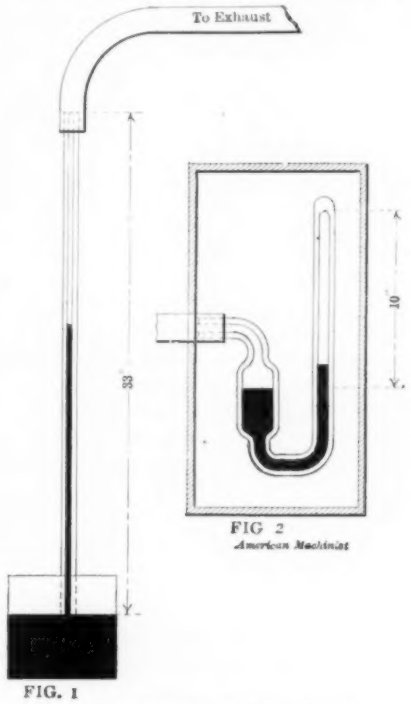


FIG. 2
American Machinist

FIG. 1

THE MEASUREMENT OF VACUUM.

I would particularly direct your attention to the measurement of vacuum. While this is becoming one of the most important things in the whole station, its measurement at present is obtained in a most unsatisfactory and indirect manner. The vacuum gage in common use measures the difference between the condenser pressure and the atmospheric pressure. It is therefore necessary to read the barometer as well as the vacuum gage to get at the true result. Thus with a vacuum gage at 25 inches and the barometer at 30 inches, the actual pressure of the condenser is 5 inches, and this 5 inches is the only quantity that really concerns us. (The term "percentage of vacuum," which is sometimes used, is quite wrong.) Unfortunately, this fact seems to have been covered up a good deal. A high barometer helps to make a high reading on the vacuum gage, and people sometimes seem to like it accordingly, yet the increased atmospheric pressure probably decreases the actual vacuum. The lower the barometer is, the better will be the actual vacuum, altho the vacuum gage will show a worse result. What we require, then, is an instrument which will fulfill the following requirements: (1) It must show the actual pressure in the condenser quite independently of the pressure of the atmosphere; (2) it must be quite accurate in its readings, and not liable to go wrong.

The first requirement would be met by an ordinary Bourdon gage with an *exhaust tube* (or a similar arrangement to that used in the aneroid barometer), but with the *case* of the instrument connected to the condenser. This will measure the actual pressure at the exhaust, quite independently of the pressure of the atmosphere. Another and perhaps better way is to make use of the ordinary mercury barometer, only it must be connected up properly. As ordinarily used, Fig. 1, the mercury column balances the difference between the condenser pressure and that of the atmosphere. If we connect up as in Fig. 2, the mercury column will show simply the actual pressure in the condenser, and quite accurately. When the mercury rises 4 inches in the tube, it means just that there is a pressure in the condenser which has an effect upon the back of the piston of a reciprocating engine, as if the piston were lifting a layer of mercury 4 inches deep. I think that this concrete idea helps us to understand the reality of the stuff left in a 26-inch vacuum, and how it is that good work may be got out of this stuff, if it is allowed to flow into a still lower pressure. For most purposes, with the Fig. 2 instrument, a 10-inch tube is quite long enough, for this will show a vacuum as low as 20 inches. The instrument can therefore be made in a neat and cheap form. The idea is not new, of course, but so far as I know it has not come into common use. Whether or no it would be better to speak of a 29-inch vacuum as being a 1-inch back pressure, time alone will show.

It is to be noted that the reading of any vacuum gage is materially altered by its position. If it be placed low down, then water will collect in the tube leading to it, and the weight of the column of water will affect the reading. Probably this fact often accounts for the difference of reading between the gage on the engine exhaust pipe and the gage on the condenser, as much as the drop of pressure between the two due to loss in the connecting pipes.

Seeing the enormous importance of good vacuum with large turbines, I have thought that the subject would prove worthy of your interest.

Roll Turning.

BY W. S. STANDIFORD.

Among the various trades in the world that of roll turning occupies a position that is important if not unique. It is an occupation that is little known, except by those who work in rolling mills, as the average person generally has a very hazy idea of the trade.

Roll turning was invented, or at least begun, in 1784 by Henry Cort, and since then the trade has been developed by various roll turners and mechanical engineers, each one having added his mite. While the art of roll turning has advanced rapidly, yet, curiously enough, there have been very few improvements in the lathe by which the roll turner produces such excellent results. The changes which have been made relate to minor details, such as adjustments to facilitate the "topping" of rolls quickly, fastening the tool-rest, tailstock, shape of housings, and a few other devices. The fundamental principles of working remain the same, and it would seem that they always will, despite the march of progress in other directions.

LATHE FOR ROLL TURNING.

The roll lathe is a machine of extreme simplicity, the turning tools are of such a character and the methods of working them are such as are found in no other line of work. The machine, built in various sizes, consists of a long and wide bed, hollow in the middle to hold the turnings, technically called "swarth." There are the necessary gearing and pulleys to drive the machine at one end of the bed. Revolving on a hollow shaft connected with the gearing is a heavy face-plate which has bolted on to its face, in the middle, a square box with fluted insides. Projecting outside of the box is a square piece of iron about 18 inches long with fluted sides; this is called a "spindle." Over this spindle is placed a round iron box about 8 inches long and fluted inside; this slides freely on the spindle. This arrangement is used to drive the roll when it is in the lathe. All rolls are made with a journal or neck on each end, and also with a fluted wabbler on the extreme end. The wabblers are of such a size that the round box on the end of the spindle is placed half way on the latter and also on the roll. This makes a very flexible or accomodating driver.

Placed across the bed of the lathe are two gray-iron "housings." There is a rectangular space in the middle of each housing containing an iron block with the upper end hollowed out and lined with babbitt, these blocks forming the bearings for the necks of the roll. The bearings are arranged to have some end play, this being adjusted by set-screws on the housing. The back ends of the latter usually have small blocks of iron operated by set-screws to form the back bearings. The caps for the bearings are formed of long rectangular pieces of gray iron with semi-circular depressions in the middle to fit the roll necks, and each having a round hole of sufficient size to go over the back ends of the housings. The front ends have inverted U-shaped slots. Thru these extend long iron rods each threaded on the upper end and carrying a nut and washer. The lower ends of the rods are slotted and are held in place by keys. The back ends or uprights of the housings where the caps go over also have rectangular slots and removable keys which, with the aid of the threaded front rods with their washers and nuts, keep the top bearings or caps pressing down on the roll. The latter is put in the lathe, and so adjusted that there is a quarter of an inch clearance between the face of the driving "spindle" and the end of the wabbler on the roll. The spindle being turned around until the flutes in it are opposite the flutes in the roll wabbler and the box being pushed half way on the wabbler. The caps are then placed on the necks of the roll, the keys are put in the back ends and the nuts on the front ends are tightened. The set-screws that operate the bottom bearings are then screwed up to prevent end play of the roll, also the back bearings are pressed against the necks by the screws in the backs of housings. Across the front ends of the housings is placed a long rectangular casting containing two T-slots, one at the front and the other at the back; there are also numerous square holes down thru from top to bottom. It is held from sliding endwise by lugs cast on the bottom, with set-screws pressing against the housings. The front ends also of the casting are provided with set-screws to hold it in place. In the T-slot next to the roll is placed the tool carriage, a rectangular forging with tongues on the bottom which allow it to slide freely in the slot. In the front slot is located the pusher, which is a solid piece of iron with a tongue on the bottom and having a long set-screw which is used to feed the tool into the roll.

TOOLS FOR ROLL TURNING.

There is considerable difference between roll lathe tools and regular machinist lathe tools, their shapes and methods of working being entirely different. In order to show this clearly, we will suppose that a groove is to be turned in a roll for making bar iron. The tool consists of a piece of hardened steel 1¼ inches thick, 12 inches long, the width depending upon the size of groove wanted. In this case it will be 4 inches wide. The front end being ground to a straight edge, the right and left sides of the tool are ground a few degrees off a right angle, so as to leave the groove with a slight clearance, the bottom and sides of the tool also being tapered so as to clear the roll, leaving the top edges to do the cutting. The tool is placed in the tool carriage, a small flat piece of iron packing is placed on it, and an iron wedge is driven in to hold it in place. A post containing a set-screw is then put into one of the square holes in the rest opposite the front of the tool, another post being placed in the other side near the rear end. The pusher is then placed in position back of the tool and the lathe is started up, the wrench on the pusher being turned until the tool begins to cut, this being followed up by a turn at every rotation of the roll to keep the tool cutting.

Should the roll be calipered at this juncture, it will usually be found that the cut is not going in straight, one part of the roll being cut deeper than the other. This is remedied by giving the shank a light tap with a hammer or else by pressing the shank over by operating the set-screws in the side posts. In managing the tool and handling the calipers there is considerable difference between the roll turner and the machinist. The latter sets his calipers in beginning new work a little larger than the finished size wanted, and feeds the tool, held by the slide rest, into the work by hand, calipering with the set spring calipers until he has the desired size. Then he connects his slide rest with the lead screw and the tool is dragged sideways along the work, cutting on the side and point. The V's on the lathe and carriage insure that the work is turned straight. In roll turning, in order to keep the cut going straight, the groove has to be calipered often. When it is within 1-32 inch of the finished size, the workman takes the roughing tool out and puts in the finishing one, which is very sharp, takes a light cut and allows it to run out, when the groove will be found to be accurately round.

In turning the necks or journals for rolls, the housings, rest and driving box and "spindle" are removed from the lathe and the roll is run on centers. A driving dog is slipped over the end of one wabbler, its bent ends pressing against lugs on the face-plate. The tool rest for necking is a casting about two feet wide, having the slots and holes on its top, as previously described. This rest is long enough to go across the bed, the hight being such as to allow the tool to be one inch below the center, which gives better cutting power to it. A machinist's tool is usually set to cut on the center or above it. Roll turners' tools will not cut above the center nor if placed on the exact center, but always have to be placed below.

POWER REQUIRED FOR ROLL TURNING.

The power required for roll lathes varies with the width and angle of tool used, weight of roll and material turned, such as "sand," chilled or steel rolls, and also with the heaviness of the cut. Using a 3½-inch wide tool and taking a heavy roughing cut on a steel roll, 7½ horse-power is required to turn the lathe. Taking a finishing cut with the same sized tool, and on the same roll 3¼ horse-power was needed. These results were taken from actual tests and were gotten by electrical measurements, the lathe being driven by an electric motor of 15 horse-power. Heavier cuts can be taken on "sand" than on steel rolls. This is due partly to the tougher nature of steel

and also to the drawing-in action which is exerted on a tool when a steel roll is being turned. When a very heavy cut is taken, the roll continues to draw the tool in until the latter has overreached its maximum cutting capacity, then the weight of the roll comes on to the tool, bending the prop under it and breaking the tool. For this reason it is advisable not to take too heavy cuts in working steel. It must be understood that the above-mentioned width of tool is not the widest that can be used on roll lathes, various sizes being used. Width of tool used depends also on the power supplied, some belt-driven machines having all they can do to pull a cut 6 inches wide. Steel for roll turning should be very high in carbon, 1.50 per cent. making fine tools. This has to be heated carefully by the blacksmith, so as to avoid burning; a cherry red being the highest that it will stand. When rightly heated and hardened it gives fine service, and takes a good, sharp edge. High-speed steel has not been tried yet for roll turning to any extent, but it would seem that there is a brilliant future ahead for steels containing 4 per cent. of nickel and also 5 per cent. of chromium. It is a well-known fact that all tools have to be harder and tougher than the materials they are turning in order to do any cutting. When they are nearly matched for hardness, the tool has to be ground very often. Very few employers seem to realize this, thinking that "any old thing will do," and buying cheap steel. The hardest material the roll turner has to turn is chilled iron rolls, these being nearly as hard as the tools used to turn them, and nowhere does poor steel show to such a disadvantage.

Nickel steel possesses great toughness and hardness, being about 45 per cent. tougher than the best grades of tool steel sold in the market. High carbon nickel steel would make most admirable tools for chill work, on account of having the above mentioned qualities.

There are two stages in roll turning, one called "turning" and the other "dressing." Turning is the making of new rolls out of the rough castings as they are received from the foundry. New ones do not have to be turned every day in ordinary sized rolling mills, tho in large ones they always keep some journeymen on new work. Roll foundries turn out rolls finished, all ready to be put in the mill, as well as castings in the rough, thus giving employment to quite a number of workmen. After the rolls have been for a time in use in the mill the grooves become rough and worn and they need to be sent to the lathe to be put in good shape. The roll turner takes off just enough metal to true them up, so that they will turn out smooth product again. This is called "dressing." The amount of cutting required varies greatly, depending chiefly on the kind of metal in the roll, the length of time they have been in use and the character of the metal rolled. As a general rule the individual rolls earn thousands of dollars for the company before being consigned to the scrap heap, altho it does occasionally happen that a new roll breaks in two or has a neck twisted off after a few hours of use.

The rolls that are mostly in use by the mills are "sand," chilled, semi-steel and steel rolls. Each of them has its good qualities for certain purposes. Sand rolls are made by pouring the metal in a mold made in sand, the best ones being made of "gray" mottled iron, this material giving excellent results for bar iron rolls, etc. Chilled iron rolls are made by casting in a metal mold. When the molten iron comes into contact with the sides, it cools quickly on the outside to a depth of 1½ to 4 inches and over. Chill depth depends upon the size of the rolls and the material that they are to make, it being the usual practise of founders to leave the center soft and tough, so as to prevent breakage or the necks being twisted off. The special feature of this class of rolls is their extreme hardness, a file making no impression on them. The best ones are made so hard that a first-class center punch will just make a mark and no more. This gives a degree of toughness to the dense brittle nature of the material and helps to some extent to prevent the rolls from breaking so readily. These rolls are used to a great extent for finishing work, the grooves keeping their shape quite a while before requiring dressing. In using them care must be taken that no cold bars are run thru, as these pieces of the groove are liable to break out.

STEEL ROLLS.

Steel rolls are used where great toughness with a moderate amount of hardness is needed, they being employed for roughing, and also for shapes having delicate points, such as "finger bars," etc. They should be made of steel containing very small quantities of sulfur and phosphorus. The following is the analysis of a pair of open-hearth steel rolls, which comes very near the ideal. In actual work they stood the battering action of heavy manganese steel ingots of all degrees of hardness for nearly sixteen months, and were then relegated to the scrap heap because they became too small for the mill.

ANALYSIS OF OPEN-HEARTH STEEL ROLLS.

Carbon combined	.49
Silicon	.211
Phosphorus	.401
Sulfur	.036
Manganese	.68

The mill should be constructed and equipped with labor-saving machinery and powerful engines, so that there need be very little rehandling of coal, etc. Our modern mills are splendid examples of this, being operated with very few men and producing large tonnage at a minimum of expense. The up-to-date mill has a special shop for its roll turners, well lighted and so arranged that it can be warmed to a comfortable temperature in the winter.

ROLL TURNERS' TROUBLES.

Anyone passing thru a roll shop and observing a roll turner working naturally concludes that he has a "snap." Now, nothing could be further from the truth, as he has a lot to contend with. Iron, steel and copper all work differently in different mills. This is due to the amount of power they have to drive the train of rolls, and also to the way they heat their material for making finished stock. Rolls that work well in one mill will not work well in another, as some mills have very weak engines, and therefore the drafts of the rolls have to be eased, etc. The roll turner has to be continually on his guard when he works in different places. The advantages, however, that accrue from working in different mills are not to be gainsaid, as each one turns out a different line of product from the other. The roll turner who works in various mills gets skilled in different varieties of work, and thus renders himself fit to take a foreman position. Many do not seem to recognize this fact, and stay at one situation for the rest of their lives, thus indeed becoming specialists in their line of work, but rising to no higher position or wages than a journeyman gets. This accounts for the fact that some men are only able to do sheet work, others wire work, etc. Roving around also broadens a man, as he is bound to come into contact with people of various dispositions, and learns to overcome many difficulties in roll turning. He will get into some mills of an antediluvian pattern if he gets his situations by advertising. Considering the bad roll lathes and tools that some of these mills contain it is surprising that the roll turner can turn out anything like decent work at all. Some lathes are so worn in gearing and bearings that they can be heard a square away. The housings are so broken and patched that they do not stay long in line with the bed, but twist and spring one way or the other when a decent cut is being taken. Add to the above a roof that lets the water in on the roll and lathe when it rains, and a condition is met with that taxes the patience and moral fiber of the roll turner. Some firms put their lathes in the mill near the roughing rolls, the result being that the workman stands a first-class chance of having an eye destroyed by a flash of hot metal from the rolls. Other parties have the happy (?) faculty of placing the roll lathe in the darkest part of the mill and then generously allowing their roll turner to use a couple of small miner's lamps. These supply barely enough light in a dark mill to allow the workman to see where the point of the tool is going. In addition to all this the journeyman generally freezes in the winter and roasts in summer.

Taken in connection with the above old-fashioned mills are the methods used to put large rolls in the lathes. One of the

most curious of these was the use of a large ships's capstan. This was situated about 50 feet away from the lathe; above the latter, fastened to an I-beam and placed at a right angle to the lathe and extending 6 feet in front of it, was a traveler fitted with two ordinary ship's blocks. Located on the floor and secured firmly to a post was another block. A 2-inch rope extended from the capstan along the ground to the sheave of the block on the floor and thence to the blocks fastened to the traveler over the lathe. The lower block on the traveler contained a large hook on the end. The method of procedure in putting in a roll was as follows: The roll was placed by means of crowbars in front of the lathe; a chain sling was used with a ring in the middle and two hooks on the ends, the ends of the chain being placed around the wabblers, and the hooks run thru, thus holding the roll securely. The hook on the overhead block was run thru the ring, the capstan bars being manned by eight negroes, and the roll hoisted higher than needed, the traveler block holding the roll was pushed in until it was over the lathe, the roll being then lowered into place. This method of doing business was exceedingly dangerous, as the rope was old and had many of its strands unravelled. Had that rope broken, it is most likely that some of the men working the capstan and also those around the lathe would have been hurt or killed. Another mill had its rolls put into the lathe by means of an inclined plane, they being rolled up it by laborers with crowbars. One man would follow up with wooden wedges to hold the roll while the others secured another hold with the bars. When it arrived on the lathe rest it was rolled into position. One firm had a method of putting rolls in the lathe by means of jacks and a cribbage of railroad ties. This was accomplished by raising the roll by the jacks, then placing the ties under, letting jacks down and taking a fresh hold and putting more ties under the roll, this performance being repeated until the roll was at the requisite hight, it then being rolled into the lathe. It is most likely that such crude ways of doing business and wasting time will be done away with in the future, even in small mills.

The influence that new inventions and improvements exert upon the roll-turning trade is most important, some of the shapes that the inventor creates calling for the utmost skill on the roll turner's part in designing rolls. It may be readily seen that the roll turner holds a most important position, his trade being one that will most likely last until the end of the world.

The Pennsylvania Railroad is experimenting, in a specially equipped locomotive, with a mixture of hard and soft coal. Buckwheat anthracite is mixed with small bituminous coal. The test is considered successful so far.

Letters to the Editor.

Holding a Heat in the Cupola—A Record in Steam Engine Replacement.

At page 1729, Vol. 27, you quote from *The Iron Moulders' Journal* a statement about the Kalamazoo Stove Company with a 27-ton cast holding the heat 1 hour and 40 minutes to replace a motor. I think we can go that story one or two better. About ten years ago at the works of the Straight Line Engine Company we were running and taking off a heat of 6 or 7 tons in the foundry, with a 9x12-inch, 40 to 50 horse-power engine, when the engineer, after they had begun to pour off, tried to substitute water for steam, with the usual disastrous result. The cupola was banked, the steam pipes of the wrecked engine were disconnected, the anchor bolt nuts were removed, the frame was taken out thru the door and the wheels at the same time by another gang of men out thru the windows of the engine-room. A duplicate engine, taken from the erecting floor, was put in in the same way, the pipes were coupled, the anchor bolt nuts set down and the engine started in an hour and fifty-eight minutes, and the remainder of the heat from the cupola was run off as if nothing had happened. This not only shows how long the heat in the cupola was held, but is a pretty good record on changing a 50 horse-power engine under adverse circumstances. A Willans engine of about the same power at Thames Ditton, England, was changed during the noon hour, but they knew in advance that it was to be done, and the conditions were more favorable. JOHN E. SWEET.

Jig for Holding Uprights for Milling—Tool for Finishing Ball End Screws.

Fig. 1 shows a piece of brass that is to be milled all over on the outside. The piece is first milled on the sides marked *A A*, being held in the vise with suitable jaws, by the sides marked *X X*. The in-

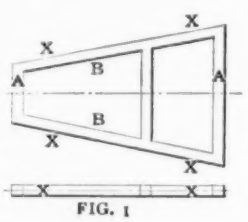


FIG. 1

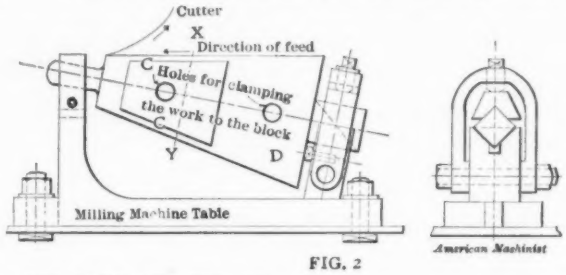


FIG. 2

THE WORK AND THE JIG.

sides marked *B B* are then rough filed; they are then ready to be fastened on the jig, Fig. 2, three on each side at a time. In fastening it is necessary to see that the pieces are held tight against the angle *C C*. They are then clamped with suitable clamps and fed in the direction shown. After doing one side the set-screw is released and the clamp is swung back, the pieces and the part marked *D* to which they are clamped are turned halfway round, the clamp is swung back and the set-screw tightened, when the other side will be ready for milling. The advantage of this method is that both sides are milled with one clamping to the jig.

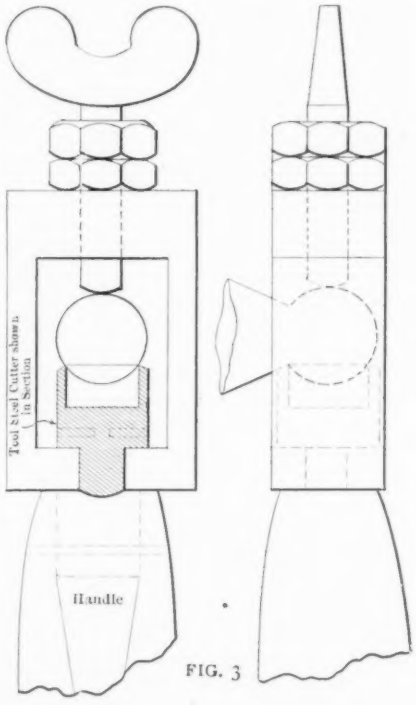


FIG. 3

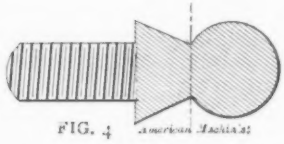


FIG. 4

BALL FINISHING TOOL AND BALL STUD.

By having two pieces marked *D* the machinist can clamp one lot while the other is being milled.

Fig. 3 shows a tool for finishing the ball end of studs, shown at Fig. 4. The pieces to be finished are first cut down and threaded. The ball and taper shown are made by a forming tool in the turret lathe. The piece is then caught by the thread in a draw-in chuck on a small lathe, and with the tool shown the tit is cut off and the ball finished a perfect sphere (about 1-100 inch being left for finish).

To use the tool, the handle is grasped

in one hand, and the other has hold of the winged set-screw. The tool is then moved freely about, the screw being worked down until the nuts on it come against the face. With the check nuts any reasonable variation in size can be got, and once the size is found the nuts are set tight. The cutter will do about 200 pieces of brass before it needs re-sharpening. Y. K.

England.

Experience With the Latest Steels.

I have read several articles in the AMERICAN MACHINIST on high-speed steels, also the criticism by Mr. Cameron, at page 1708, Vol. 27. I must confess that some of the tests I have read of sound rather strange. I note, however, that in the record tests the tools were used about as long as they would rub metal off.

I am a great believer in our modern steels, and I am of the opinion that as much care is required in selecting steel for special purposes with high-speed steel as with carbon steel. The work in the shops with which I am connected is all produced with special machines and special tools. Practically all cutting is done under either oil or a compound lubricant, but we are not troubled with any "vapor arising from the work." We do not run any work over 80 feet per minute, and some as low as 40 feet per minute; and even at this moderate speed for the modern steels I have seen "Novo" tools burn so that they were useless when a pump belt broke, and it only took a few seconds to do it.

I think myself that there is a lot of "hot air' blown off by some of the steel salesmen, but, as a rule, in case of failure the steel is all right but not suited for the job it is put on. I speak of special tools only.

We have tested in a regular way all of the high-speed steels that came our way, and have found them all good, but so far have found but one that entirely fills the bill for us. This steel is easily hardened in an open fire, has great endurance, holds a keen edge, is very tough, and the stock does not stick to it. We have run tools made of this steel (forming tools) for eighty consecutive hours, making twenty pieces per hour, which was an increase of four pieces per hour over the product of any other steel. This is not an uncommon thing now, and on the same jobs when the best carbon steel was used it was necessary to grind at least three times in ten hours. Not only do we get an actual increase per hour, but it is a large increase, as frequent grinding is not necessary.

A THREE WEEKS' STEEL CHIP PILE.

I saw a cut-off tool to-day taken from an automatic screw machine that had run for 234 hours and had cut off 5,144 pieces. These pieces were 1⅜ inches diameter with an 11-16 inch hole in them; feed about .020 per revolution. [The last chip taken by this tool has been sent us by the writer, and it is so perfect in every way that it might easily be taken for the first chip instead of the last.—Ed.]

We do not run our machines to the speed limit, having found early in the game that it did not pay to sprint for two hours and then stop for three to get tools in running order again.

I send a photograph of a portion of a chip pile. This pile of chips was made in a little over three weeks. When we are busy about 4¼ tons of chips are put here each day. It takes three men to handle the chips—that is, to take them away, so that the men won't get lost, and to extract the oil from them.

LE ROY TABOR.

Eclipse Mach. Co., Elmira, N. Y.

A New way of "Laying Off" Templets.

Being an amateur photographer and also a toolmaker, I was greatly interested in the article at page 1743, Vol. 27, under the above title.

Dixie professes great faith in the process described "when precision is essential." I have had some experience in photography along mechanical lines, but have never found any great precision about a photograph of any kind. I cannot imagine a lens ground so correctly that it will not distort an image to a much greater extent than the .0001 inch spoken of by Dixie. Really, I do not believe any lens made will stand such a severe test. Again, the drawings, made as Dixie suggests, one hundred times as large as the finished picture is to be, would have to be set into some concave surface, the radius of whose concavity would be equal to the distance from the lens of the camera to the enlarged drawing, in order to insure the result being at all accurate, as the veriest amateur "camera fiend" has found in taking pictures of groups, that if his subjects are not arranged in the form of an arc, those who are slightly nearer the camera appear to be veritable giants compared to the others; so the slightest difference in distance from the lens of the various parts of the drawing could not but affect the accuracy and symmetry of the image on the ground glass at the back of the camera. I find that the distance from the lens to the drawing in my camera, when reducing from 100 inches to 1 inch, is approximately 54 feet, my camera being fitted with a rectilinear lens.

With the camera 54 feet from the drawing, the outer edges, if the drawing were flat, would be about 2 inches farther from the lens than the center is. This would surely be sufficient to destroy any great accuracy.

In addition, it seems to me, even if the image *may be* correctly impressed upon the dry plate, as the plate must be developed and washed—development and washing having the effect of swelling the sensitive emulsion or film on the plate to something like four times its normal thickness—which is then dried before printing, it is a little too much to expect that the image on the finished negative will be precisely the same size as it was when taken from the camera immediately after exposure.

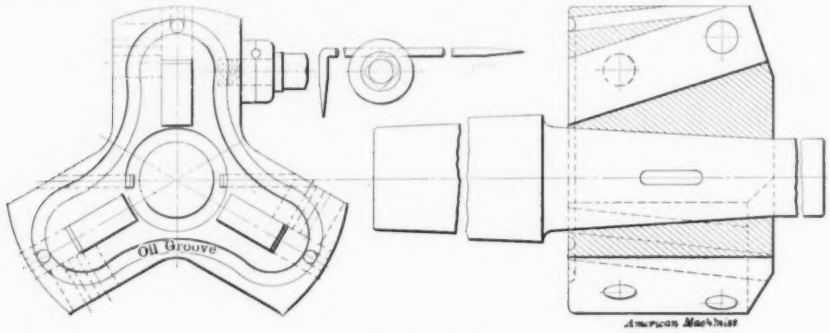
Dixie says that photographers outside the shop produced pictures "correct in total width." Surely the photographer who can produce a negative of a drawing which will stand the test of that ".0001 inch" must be a prodigy, as I believe that is closer than most photographers usually measure. Last, but not least, I cannot un-

derstand how *anyone* could measure, with any accuracy, an image on the ground glass provided for focusing the camera, as, of course, the ground side of the glass is on the inside of the camera.

A. MATEUR.

A Boring Head.

The boring head shown is a very useful tool and can be made at a very small cost. This particular tool was made to bore out connecting rods on the vertical milling machine. The head proper is made of soft steel and is slotted to carry three self-hardening steel cutting tools, 5/8x1¼ inches, each held by two set-screws at the side. The tools are inserted on an angle, to permit them being adjusted to different diameters of bore.



A BORING HEAD.

It was found convenient to attach a scribe, or scratcher, for centering purposes, the same as any other centering operation requires; it is also used in setting the tools by first scribing a circle the desired diameter and setting the tools down to this line. An oil groove is cut around the top of the head, and a small drill run down toward the cutting point of the tool. Into the head is fitted a tapered arbor fastened by a key, the upper end of the arbor is made to suit the socket in the spindle of the machine, and the lower end long enough to form a guide.

PAP.

The Negro Machinist.

No doubt the fact of being black often gives a negro the blues. Your correspondent says at page 1710, Vol. 27, that there is now less opposition to a self-respecting negro and that the negro question must be settled by the best thinking white men and themselves.

I have never given the matter much study, but it seems to me that he is thinking about right when he has come to the conclusion that the question must be settled mainly by the negro himself, with what good help he may get from other good people who may interest themselves in his behalf.

This negro machinist must not think he is the only one that has his battle to fight. Each man's success depends on himself and good fortune, and must often be fought alone. In some parts of this country you will find the shopmen complaining of the "durned Swedes," in other parts the "d——d Dutch," and so on.

The main cause is that these men at first work cheaper and help hold wages down that might otherwise be better. It doesn't seem reasonable to think a boss would employ a negro at the same wages he could get a white man for, and put him among them and run the chances of trouble by so doing. Many men would no doubt say the "d——d nigger" and still not know just why they had a right to complain if the fellow was a good workman getting good pay.

Suppose the shop were full of negro machinists with one or two white men, they would feel out of place just as well as this negro, and get at most no more chance than he did. I think the employer has a right to employ any proper person he sees fit, and I also think the men have the same right to say whom they will work with, be it negro, Chinaman or Eskimo.

It may be the negro's misfortune that he was born black, but we can't help that any more than he can. The white man's misfortune is that more is expected of him, and he is less easily satisfied. I like to see any person treated fairly, but at the same time I don't wish to see different tongues and colors mixed too much in the shop, theater, church, or at home.

CAMERON.

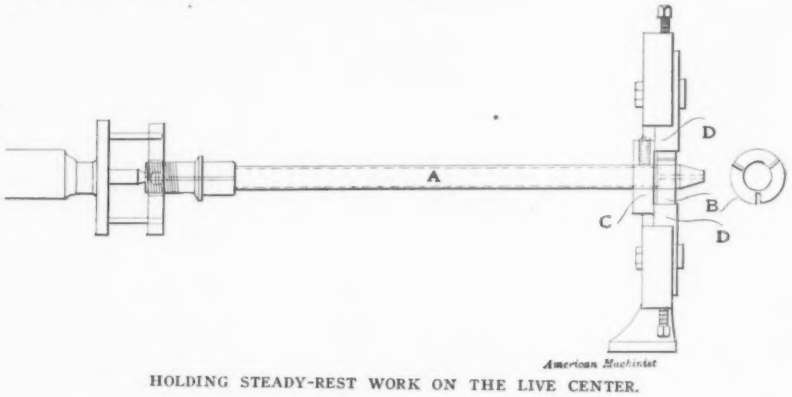
Holding Steady-Rest Work on the Live Center.

The hook bolt shown at page 1617, Vol. 27, may be all right on ordinary work, but on a piece like that shown in the sketch it would not give accurate results; that is, of course, where the pieces are to be finished absolutely true.

I think the sketch will clearly show the very simple way in which I held these quill chucks against the live center. The stem *A* of these chucks is ¼ inch standard and 9 inches long. A brass collar *B* was drilled and reamed ¼ inch, then slotted as shown to take up wear, and then inserted between the jaws of the steady-rest. Another brass collar *C* was drilled and reamed ¼ inch and a small set-screw put in to fasten to *A*. When the chuck *A* is put in position it is held against the live center, and collar *B* is adjusted so as to bear against the faces of the steady-rest jaws *D* and secured by the set-screw. Two pins were put in the drive plate opposite each other and the driver adjusted to bear on both ends so as not to spring the chuck, which springs very easily, the metal being only 1-16 inch thick.

A hole was drilled and reamed in both ends of the quill chucks, concentric with the outside, without any trouble.

A. J. DELILLE.



HOLDING STEADY-REST WORK ON THE LIVE CENTER.

Standard Size Publications.

The Rand Drill representative, whose interview on "Standard Size Technical Publications" was published in *Printer's Ink* and referred to in the AMERICAN MACHINIST at page 1701, Vol. 27, has absolutely the right idea.

This movement toward standardization should have kept pace with other of the numberless economies and simplicities that have been devised and introduced with the big industrial consolidations. The accompanying photograph will illustrate my method of keeping near at hand, in condensed form, in binders sufficiently large for six months, the current technical publications.

How much better it would be for many reasons, which will at once be apparent on thought, if all these binders were one size. I do not include in the binding any of the advertising matter, excepting only the last issue received by me. In this connection, and of vastly greater importance, would recommend that manufacturers generally adopt a standard size catalog, the pages of which would be, say, just the size of the regular commercial letter paper. Think of

the economies this would work! The costly bindings, the front page covers, the ceaseless striving for new and expensive lithographs for covers, the establishment of a running book, as it were. New cuts, new prices, new literature, could be sent out in single sheet form, all properly perforated for placing in the standard file or binder. The binders could be purchased by the concern owning the catalog, and a neat, uniform library could thus be set up and maintained in every purchasing department. T. B. HOWELL,

Mgr. Bond Plant, American Radiator Co.

[We do not reproduce the photograph. It is sufficient to say that it shows the "ragged sky line" so often criticised as a feature of New York since the craze for high buildings set in. In a letter subsequently received from Mr. Howell he states that he did not know that standard sizes of catalogs had been adopted by any particular line of industries, but of course the main thing is his endorsement of the idea of *some* standard.—Ed.]

Adjustable Threading Die.

The accompanying sketch shows an adjustable threading die which can be easily

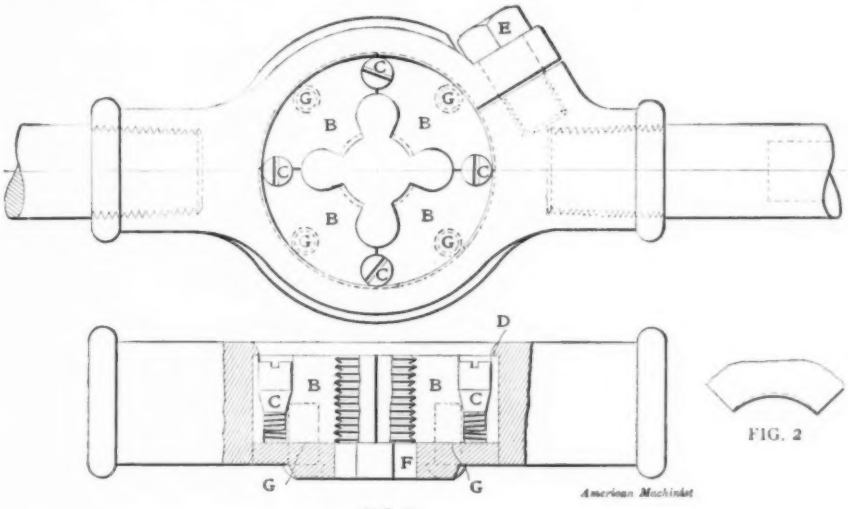


FIG. 1

ADJUSTABLE THREADING DIE.

ground on all of the cutting edges when they become dulled from use.

The detachable handles are made of pipe with a solid end welded in as shown at *A*, making them very strong and adding but little to their weight. The dies *B B B*, Fig. 1, are adjusted for size by the taper shank screws *C* which have their tapered part near the center to avoid any tendency toward tipping the dies which might occur if the taper continued to the heads. The dies rest against the small flange on the stock at *D* and are clamped firmly together by the screw *E* and are also secured to the guide plate *F* by the screws *G* which draw them down evenly on the surface of the plate, holding dies and guide plate together when not in the stock. The holes in the guide plate *F* are slotted slightly for the screws *G*.

With the threads finished with a sizing tap a little below standard size (say, .005 inch small for a ½-inch die), thus giving the die thread clearance, as shown exaggerated by the dotted line in Fig. 2, a very easy and smooth cutting die results.

By moving each of the screws *C* an equal amount when making adjustments the die is adjusted radially in or out, as the case may be, keeping the chasers in the proper position to do the best work at all times. M. H. BALL.

Molding Worm Gears.

At page 1514, Herman Jonson in describing his molding of worms and worm gears gives a sketch of a rig for drawing a worm pattern which is of course the ideal thing where sufficient quantities are required to warrant the outlay; but for the benefit of those who may be called upon, as I have been on several occasions, to produce, say, about six each off different patterns, I would like to describe a method I have used and found to give entire satisfaction, both as to cost and the quality of the castings, which come out fairly true so that they require very little dressing to make them work well if bored true.

FIG. 2

First of all, I make a plate (which may be termed a stripping plate) out of sheet iron about 3-32 or ⅛ inch thick to fit over the end of the worm pattern, each projection being tapered off to the same rake as the worm. Toward the outer edge of the plate are drilled holes to fit over the pins on the flask. The plate can be secured by weights or by cotters thru the slots in the pins, and then all is ready for molding. The pattern is placed on a board with a hole in it to locate and keep it upright, and the nowel is put on and rammed up. Then the whole is turned over, the board is taken away and the cope is rammed up, the down gate is put in and the cope is lifted off, leaving the whole of the pattern, with the exception of boss and core print, in the nowel. Now, instead of the fixture as described at page 1514 for drawing the pattern, the plate described above as the stripping plate is put into position and held by cotters or weights, then an ordinary lifting pin is screwed into the pattern and the pattern is twisted out of the sand, the plate not only acting as a guide to give the required twist, but also protecting the fine edges of the sand thread from being broken. The gate is now cut, the core placed in position, mold closed and poured. The sand being supported by the plate during the drawing of the pattern becomes nicely slicked, thus producing a fine skin on the casting. G. H. W.

Steel Cores—Making Iron Core Boxes.

Mr. Wertheim's review of the steel core process, at page 1577, Vol. 27, is exhaustive, and correct as regards the general run of work, but provides nothing for the skill necessary to perform certain operations. For instance, the place where the greatest gain was made by the use of steel cores was in a very light 12-inch 6-pitch cast bevel gear that had a bore one inch in diameter. The machining of such gears, including accurate chucking, proved to be several times as expensive as the steel core process, and was abandoned in favor of the latter. Other comparisons showed in favor of machining, and they were accordingly settled in that way.

The discussion gives me an opportunity to describe a time-saving method of producing appliances quite as useful in making perfect sand cores for similar work. When it is impracticable to use standard cores from a core machine, often a gray-iron core box is made in halves with the required shape cast in it as smoothly as is possible, and, after being finished on its contacting surfaces and doweled together, it is finished smooth by laboriously filing and scraping the recesses.

The method which I describe now I saw in use by a patternmaker for a large implement factory in Madison, Wis., and I am sure that for rapidity and convenience it is unexcelled.

The halves of the core box, made from perfectly plain gray-iron plates, are finished all over and doweled together with long, straight pins. A fluted reamer is carried in stock having its body size the diameter of the body of the core, its end the required length and taper of the print, and a straight shank the diameter of the small end of the print. Holes the diameter of the shank of the reamer are laid off and drilled central with the joint, or half in each side of the box. The halves of the box are then separated as far as the straight pins will allow and the box placed on edge in a drill-press vise, and the reamer lowered between the sides to the correct position lengthwise. By rotating the reamer and gradually closing the vise the sides are brought together with the reamer enclosed in the box, and then, by feeding the reamer down to depth, one side is perfectly finished. The box is then reversed, and the opposite end of the

core body is completed, and the result is a perfectly true and smoothly finished core box. The first drilled hole always acts as a guide for the reamer, acting on the shank, which is of the same diameter.

LUCIEN I. YEOMANS.

Shop Systems.

In most of the successful manufacturing workshops (especially in the engineering trade) shop system has been the one important factor where quick and accurate work has had to be produced at a very cheap rate. It has been the means of specializing every branch of the trade by making the man that works on the lathe a specialist in that class of work, and the same with the milling machine man and vise man.

One important factor in shop systems is the subject of speeds and feeds. In most up-to-date shops to-day we find what is termed the "speed boss," whose duty it is to see that every machine is speeded up to its full limit. This position, as many know, is not an enviable one. The workman considers that he is being driven with a whip while from the point of view of the speed boss the workman is apt to be looked upon as a machine. These are points that require consideration, as it both affects production and quality of work turned out.

With this in view, I desire to throw out a few suggestions which may alleviate the present position. The object of these suggestions is to show the workman the capacity of the particular machine upon which he may be employed, by placing a plate upon it similar to those placed upon lathes, giving the wheels suitable for the proposed threads to be cut. This plate must give him the speed of each cone step with and without back gears, and the size and class of material that could be worked at those speeds; if a milling machine, the feed that could be taken at those speeds; if a lathe, the cuts per inch.

I will give a few examples which I hope will make the subject clear. They are only given as examples, it being left to

Driving Cone on Machine			Without Back Gear				With Back Gear			
Rev. of Countershaft	200	Rev. of Spindle	600	360	225	140	71	42	26.5	16.5
			Diameter of Material				Diameter of Material			
		C I / M S	0.400	0.600	0.900	1.400	2.800	4.800	7.500	12.000
		C S	0.200	0.300	0.500	0.700	1.400	2.400	3.800	6.000
	250	Rev. of Spindle	750	450	281	178	88	52	33	21
			Diameter of Material				Diameter of Material			
		C I / M S	0.300	0.500	0.700	1.125	2.300	3.900	6.000	9.500
		C S	0.150	0.250	0.350	0.550	1.125	2.000	3.000	4.750

American Machinist

FIG. 2. SPEEDS FOR 14-INCH HENDEY-NORTON LATHE.

DRIVING CONE ON MACHINE			WITHOUT BACK GEAR						WITH BACK GEAR							
REVS. OF COUNTERSHAFT	90	Revs. of Spindle	212		148		106		76		34.5		24		17		12.5	
			Dia. of Cutter	Feed per 1 Rev.	Dia. of Cutter	Feed per 1 Rev.	Dia. of Cutter	Feed per 1 Rev.	Dia. of Cutter	Feed per 1 Rev.	Dia. of Cutter	Feed per 1 Rev.	Dia. of Cutter	Feed per 1 Rev.	Dia. of Cutter	Feed per 1 Rev.	Dia. of Cutter	Feed per 1 Rev.
		C.S.	.500	.006	.750	.006	1.000	.012	1.250	.012	3.000	.030	4.000	.041	5.500	.057	7.000	.078
		M.S.	1.000	.012	1.250	.012	2.000	.022	2.500	.022	6.000	.057	7.000	.078	11.500	.098	16.000	.146
		C.I.	1.000	.022	1.250	.022	2.000	.041	2.500	.057	6.000	.098	7.000	.146	11.500	.187	16.000	.187
		B.	1.000	.022	1.250	.030	2.000	.041	2.500	.057	6.000	.098	7.000	.146	11.500	.187	16.000	.187
			WITHOUT BACK GEAR								WITH BACK GEAR							
	150	Revs. of Spindle	354		246		176		127.5		57.5		40		28.5		21	
		C.S.	.250	.006	.375	.006	.500	.006	.750	.009	1.750	.016	2.500	.022	3.500	.030	5.000	.057
		M.S.	.500	.006	.750	.009	1.250	.012	1.500	.016	3.500	.041	5.000	.057	7.000	.078	9.500	.098
		C.I.	.500	.012	750	.016	1.250	.022	1.500	.030	3.500	.078	5.000	.098	7.000	.146	9.500	.187
		B.	.500	.012	.750	.016	1.250	.030	1.500	.030	3.500	.078	5.000	.098	7.000	.146	9.500	.187

American Machinist

FIG. I. SPEEDS AND FEEDS FOR NO. 1½ CINCINNATI UNIVERSAL MILLING MACHINE.

those in charge to decide upon their own feeds and speeds according to conditions.

In the first example, Fig. 1, I have taken a Cincinnati milling machine. This shows at the top the cone pulley on the machine arranged according to the speed, a cross signifying the step on which the belt must be placed to give the speeds for the cutters of which the diameters are given. The two speeds of the countershaft are given; also the speed without and with the back gear. The symbols "C. S." will be recognized as cast steel, "M. S." as mild steel, "C. I." as cast iron, and "B." as bronze.

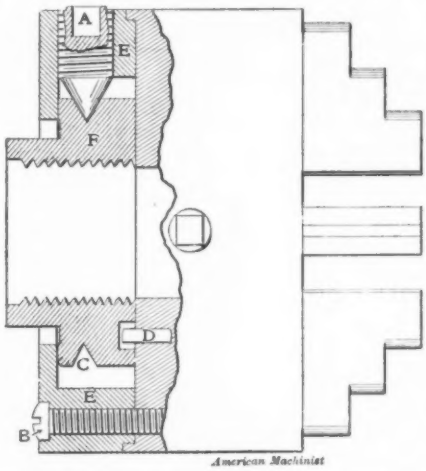
The second example, Fig. 2, relates to a Hendey-Norton lathe. The layout of this is the same as for the milling machine, with the exception that the feed is not given, but only the diameter of material that could be successfully worked at those speeds.

This system would also be of great importance in piece and premium work, as the speeds and feeds given could be used as a basis for all calculations of the time required to do the work specified. A certain percentage could be allowed for setting up the work and fixing of the tools.

Birmingham, England. Novo.

Compensating Mounting for Universal Chuck.

I send you a sketch of a mounting for a three-jaw scroll chuck by means of



COMPENSATING MOUNTING FOR UNIVERSAL CHUCK.

which its position may be adjusted radially to compensate for wear of scroll or jaws. It can be used also for turning small eccentrics. When work is found to be not dead true after the jaws are tightened correction is made by applying the chuck wrench to the adjusting screws *A*. There are three of these screws tapped into the steel ring *E* which is fastened to the back of the chuck by screws *B*. The lip of this ring laps over the back of hub *F*, which is fitted to the lathe spindle, and holds the chuck without shake. A V-groove is turned around *F* for the points of screws *A*. There are three dowel pins *D* driven into the back of the chuck and projecting into enlarged holes in the face of *F*. These serve as drivers for the chuck and still allow it to be moved radially as required.

The proportions can be arranged according to the diameter of the spindle screw and the outside diameter of the chuck. This is not patented, so far as I know, and is original with myself. It would be very useful in any shop not equipped with spring wire chucks, as it will do almost everything that a spring chuck will do and work on larger diameters than is possible with spring chucks.

J. A. Peterson.

Dimensions on Drawings.

I was much interested in the article at page 1570, Vol. 27, by F. H. Fisk. For several years I traveled in this and other countries erecting machinery, and while doing so came in contact with a large variety of drawings. The worst I remember was in a well-known engine shop in New York State. After getting things limbered up and in working order I was handed a large blueprint on which was a stud I was supposed to make. I looked at it and saw there were no figures but that each dimension was indicated by a letter. I found up in the corner of the drawing a list saying A = $1\frac{7}{64}$, B = $8\frac{3}{16}$, and so on. As the stud required two handlings, I proceeded to add the several lengths which would come in the first handling. I got my thumb nail carefully located in the line on the scale that denoted A, then found B, and was looking for C, when someone bumped my elbow; my thumb slipped, and—well, it is unfortunate to begin the day with an accident like that.

The foreman of a lathe department where work is done that is to be assembled in other parts of the shop should have a drawing that will tell him what is wanted. Then that drawing should be his law.

Of the shop that does not have brains or business enough to keep its holes drilled and reamed to standard size I have nothing to say, but where holes are kept standard size there should be a regular allowance per inch diameter for a drive or running fit, and this should be marked on drawings. I am in favor of the drawing marked 1" — .001 or 1" + .002, rather than the one giving the exact number of thousandths, and if there is some collar that needs the corner taken off mark this also, not depend on the foreman to tell the man to take his file and bevel it just a bit.

M. F. C.

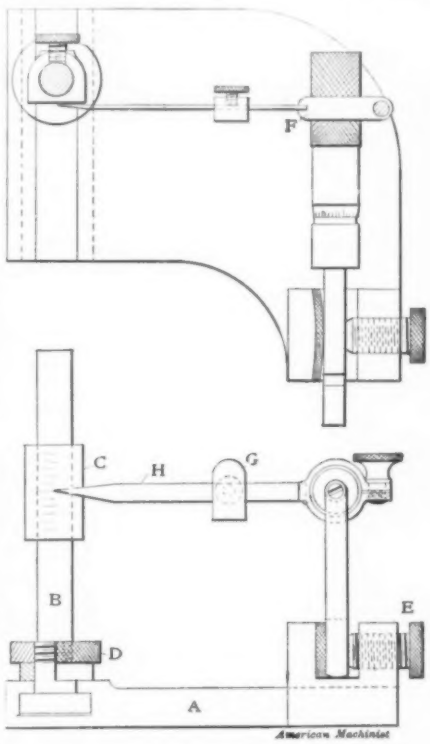
[As a general thing, those who prefer the marking referred to will find that they prefer it only because they are accustomed to it and so it comes easier to them, while a man who has been accustomed to have his drawings marked with the actual number of thousandths that things are to be made prefers that system. And the last-named practise is certainly more logical and we think to be preferred.—Ed.]

Measuring Plug Gages With the Micrometer.

In accurate measurements one person differs from another, one having a fine or light touch and the other a heavier touch, in many cases the difference between the two will be one ten-thousandth of an inch.

Having a number of plug gages to make and to avoid any disagreements as to the accuracy of the measurements, the device shown herewith was designed and built very cheaply to hold various sizes of micrometers. The base *A* is of gray iron; across this the T-slot is milled for the rod *B* and no other machining on the base is required. On the rod is a graduated slide *C*, each space representing .0001 inch. This slide can be adjusted to different size micrometers as to hight, and the rod, which is clamped to the base by the nurled nut *D* and washer, can be moved forward and backward to suit the micrometer.

The micrometer is clamped to the base by screw *E* and to prevent any spring in



MICROMETER ARRANGED FOR MEASURING PLUG GAGES.

clamping one side is rounded and a piece of leather put in between. A clamp *F* is fastened to the micrometer head, a weight *G* is placed on the pointer *H* and adjusted to give the necessary tension desired when measuring a piece of work.

In making a number of plugs of one size, one plug is made and proven correct and used as a standard. Now clamp the micrometer in the fixture, adjust the slide for hight, the pointer horizontally, bringing the rod as near as permissible; measure the accepted standard and note the reading; the rest of the plugs can now be lapped to the same size as the standard; any variation is easily discovered by watch-

ing the pointer, as the tension is the same on all. The pointer should not be dropped suddenly, but lowered slowly until it stops by the action of the micrometer screw touching the work.

Where a large micrometer is used the slide can be inverted and turned around opposite to the position shown in the sketch. A. C. L.

Drill Jigs.

At page 1471, Vol. 27, two jigs are described by W. K. Wilber, one of which is for drilling two holes in collars. Having

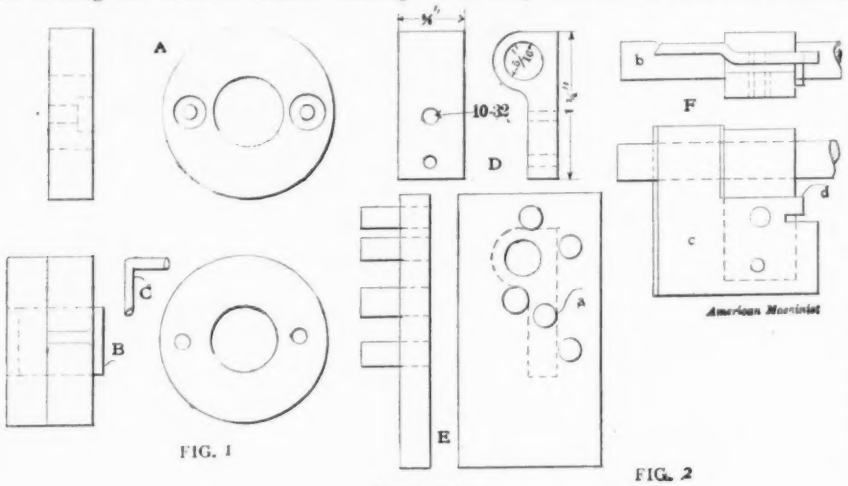


FIG. 1 FIG. 2

DRILL JIGS.

often similar work, I apply a method which seems not to be new, and that is, using one of the collars as its own jig, as shown in Fig 1. *A* is one of the collars, *B* is a plug driven in one of the collars, and *C* is a pin, which may be a piece of cold-rolled stock bent over. This pin is shoved in the hole as soon as it is drilled, to keep the collar from shifting.

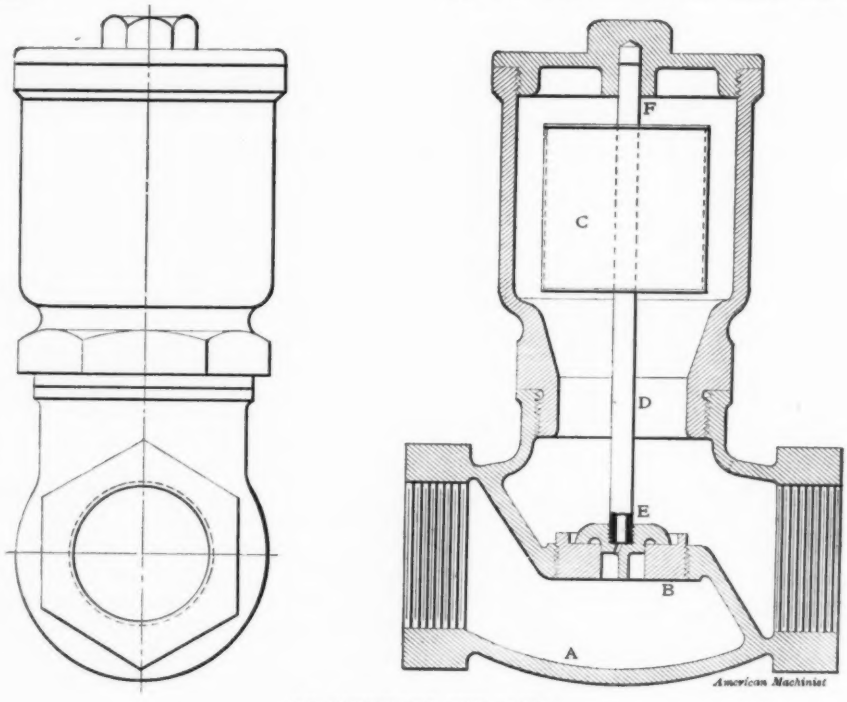
While I am writing this a little job comes to my mind, which was given to me with the usual remark in jobbing shops, "Say, D——, here is a job I wish you'd do your best on; it's contract."

At *D*, Fig. 2, are top and side views of a bracket which was cut off on a milling machine; three holes were to be drilled, and there were twenty-four of these pieces of brass. *E* is the jig for drilling the 5-16 hole. It is a piece of 3-16 stock with holes drilled and No. 12 wire pins driven in, and on the inside slightly filed, as shown in the side view, so that the piece can be snapped in. One of the pieces was laid out and drilled with the jig on the bottom; a hole was made at *a* for pushing the piece out when drilled. At *F* is the jig for drilling the other two holes, one for a 10-32 screw and one for a dowel-pin. *b* is a piece of 5-16 inch cold-rolled stock filed about 1-16 inch deep to receive part *c*, which is a piece of sheet iron filed dovetail on the edges. There was no fine fitting necessary. Plate *c* was roughly fitted into *b* and fastened by pinching. The edge at *d* in the top view was filed until it came parallel with the face of the drill press table, and the corner was bent downward so as to hold the brass piece against the side of *c*.

This was a model job; nothing very close, but the holes needed to appear alike. It took hardly a half-hour to make the jigs, and forty minutes to drill those seventy-two holes. I do not know anything simpler; may be some of your readers do. D. WINKEL.

An Automatic Drip Valve.

A very satisfactory drip valve was got up in the manner shown by the sketch. The body *A* is taken from an ordinary



AN AUTOMATIC DRIP VALVE.

globe valve with removable seat, a new seat *B* being screwed into its place to suit our case. *C* is a hollow copper float mounted on a small copper tube *D* which is screwed into the three-winged valve *E*. The valve is kept squarely upon its seat by the stem *D* being guided at the top at *F*. This particular valve was made from a 1-inch globe valve and was used in the machine shop, which was heated by many large coils of pipe on the side walls. Each coil is now provided with one of these valves and the condensation is properly taken care of. DRIP.

Casting Grate Bars.

Some time ago a man who was making grate bars (or trying to make them, as he had lost a lot) said: "Well, I didn't come here to make grate bars, anyway." A good excuse, I thought; but I have seen many a good molder fail to make a success on grate bars, and yet molders despise the job of making them, altho by making them they would learn something.

For the benefit of those who have failed I will give them a little of my experience in that line, as I have lost some myself and have been benefited by my experience. The trick is very simple when you know the way—the same as anything else.

Get your follow-board down and drag and patterns on; then riddle some sand outside the flask, take it up in your hands and throw it into the patterns between the bars till they are full; then ram up the rest of the flask, strike it off, put some sand on and then the bottom board. Rub and knock it down till it is solid all over. Take off the board and get a square strip and make some small gutters all over it to take off the vent. Put back the board, roll over and take off the follow-board. Then take a stick and lay it to lap about one-half over the cores or spaces between the bars as a guide for the vent wire. Vent the spaces all along, being careful to touch the bottom board with the vent wire every time. Now make the joint and finish in the usual way. You need not vent thru the cope, as many do, as the vent will come off at the bottom.

The most particular point about grate

bars is in the pouring. Any bar over 2 feet 6 inches long ought to be poured from both ends. Get the iron good and hot and pour it slowly, say a stream about as large as your finger. The reason so many wash and are bad is because almost everyone cuts a double gate on the end, with one side deeper than the other, and if the iron is put in the mold too fast it will fill up one side first and then over goes the core and the bar is spoiled. In pouring them slowly and with hot iron, the metal has a chance to keep its level, with no more pressure on one side than on the other, and the result is a good grate bar. In many foundries the bars are cast last, and with dull iron generally, but that is not right. It is not very good policy to keep them till the last of the heat because they are only GRATE BARS.

Standard Size Publications.

The current issue of *The Engineering and Mining Journal* has discarded its former shape and size and comes this week in the size of *Fuel* with a corresponding increase in the number of pages. The *Journal* says in commenting on the change: "With this number *The Engineering and Mining Journal* is issued in the standard size, 9x12 inches, conforming to modern practise in engineering journals and other scientific and technical publications. This size we are sure will be found much more convenient by our readers."—*Fuel.*

[It may be proper to call the attention of *Fuel,* and perhaps some others, to the fact that 9⅜ inches is not 9 inches. If places 9¼ inches wide were provided for filing periodicals of standard size, *Fuel* would be a disturber of the peace on the shelves and would be apt to be thrown out. —Ed. A. M.]

An average speed record of 24.16 knots puts the British cruiser "Drake" at the head of the naval ships of the world.

A Home-made Filing Case for Clippings.

BY OSCAR E. PERRIGO.

From time to time there have been published in the technical journals ingenious designs for filing cabinets or cases, for clippings which it is desired to preserve for future reference. Many of these are complicated and expensive to construct and considerable unnecessary time is spent in the process of filing and indexing. Many times they form a very complete and exhaustive exposition of the subjects to be handled, and are quite appropriate for the use of men who devote their entire time to the study of the subjects treated and the writing of articles upon them, or who have the leisure and the means to indulge in elaborate accessories for their work.

But for the active business man, the superintendent, the foreman, or the worker in the shop, who takes a studious interest in these matters, they are likely to be too expensive and their use so complicated that he is apt soon to tire of them and the interest which he first felt in their possession lags and finally ceases altogether.

The object of this article is to illustrate and describe what may be called a "home-made" filing case—one which may be constructed by any fairly good mechanic and at the same time answer all the ordinary requirements as well as the far more expensive and complicated kinds.

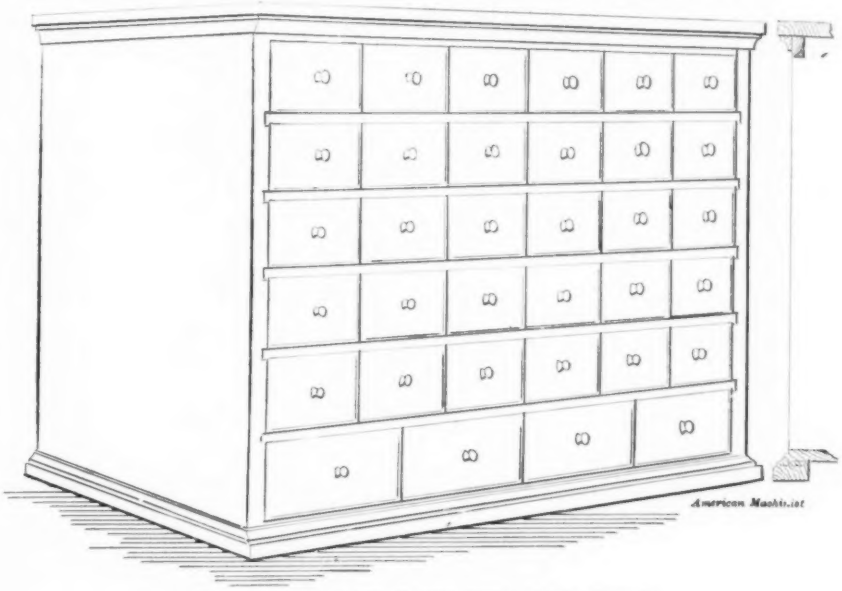


FIG. 1. HOME-MADE FILING CASE FOR CLIPPINGS.

The design here shown is the same as one used by me for a number of years, and which has proven very satisfactory. The case consists of a series of drawers, each large enough to hold a column slip or clipping of the wide column technical papers. Magazine articles are folded to this width. The drawers are three inches deep. The general form of the case is shown in Fig. 1; it may be made of white pine ⅞ inch thick, with a back 5-16 inch thick, and finished with two or more coats of shellac varnish, the first one rubbed down with fine sandpaper. The drawer fronts are finished in the same manner, while inside and out one coat will be sufficient. The moldings shown at the top and bottom may be omitted if it is desired to save expense.

It will be noticed that the drawers are

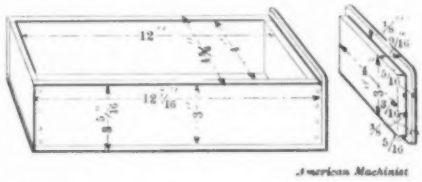


FIG. 2. DETAILS OF FILING CASE DRAWER.

placed upon shelves ½ inch thick, but that there are no fixed partitions between them. They are quite as convenient in practise when so arranged, and the cost of the case proper is thereby reduced nearly 50 per cent.

The lower row of drawers may be of greater width and used for a card index of the contents of the drawers, for new clippings not yet classified, and for similar purposes. In this case one or more of them will be made of proper width to hold the regular size of index cards, or wide enough to accommodate two columns of cards separated by a thin partition.

The detailed construction of the drawers is shown in Fig. 2. The drawer front is 9-16 inch thick with a rabbit all around, so as to show ⅛ inch at the top and 5-16 inch on the sides and bottom edges. The sides, bottom and back are 5-16 inch thick. Thus there is a flange at the top ⅛ inch high for excluding the dust, while the sides and bottom are flush. The front corners of the drawer fronts are rounded so as to form an agreeable finish. The drawers are provided with small brass knobs, altho drawer "pulls" may be used if desired.

In the use of this filing case each drawer may be utilized for clippings on one subject, or division of a subject, or for those of a certain class of machinery, or any similar classification of subject matter that may be desired. Short items may be pasted on thin cards 2¾x11¾ inches. As the clippings are all laid loosely into the drawers obsolete matter may be very readily removed. The number of drawers may be varied to the wants of the individual, but should not ordinarily consist of less than twenty-four of the smaller drawers, and it will probably be found better if there are thirty, as shown in the drawing. A greater number will hardly ever be needed. They should be numbered for convenient reference on the index cards, and have a title descriptive of the contents placed under the knob. A series of small brass label holders such as are put on printers' type cases may be used to carry a card which is slipped into place and is readily removable should the contents of

the drawer be changed. A card 2¾x11¾ inches may be laid on top of the clippings in each drawer and contain a list of the matter in the drawer, if this method is preferred to the card index. Or, better yet, both may be used, the card index referring only to the number of the drawer.

I have used one of these cases on the end of a long writing and drawing table set in front of a large window. Upon this case stands a case of open shelves upon which are kept hand books and such other reference books of mechanical and scientific subjects as are used most frequently. It makes a very compact and convenient outfit.

Interchangeable Parts and Running Fit Limits.

BY GEORGE F. SUMMERS.

As literature on this subject is scarce, the following information is given for the use of draftsmen:

Table No. 1 is recommended for use in the ordinary shop and is suitable for parts of harvesting machinery, bolts, nuts across flats, wrenches and all places where loose fits are not objectionable. Chart No. 1 is a graphical representation of this table. It is thought that table No. 1 will generally give good enough fits and keep the cost of manufacture within reasonable limits.

Table No. 2 is for fine work and advances by ten-thousandths of an inch. Where nice fits are required this table may be used, but it must be remembered that the cost advances rapidly as one holds the machinist down to close measurements.

Nominal Size.	Clearance.	Tolerance.	Receiving			Entering.		
			Maximum Limit.	Desired Size.	Minimum Limit.	Maximum Limit.	Desired Size.	Minimum Limit.
1 16	.003	.001	.064	.063	.062	.061	.060	.059
1-8	.003	.001	.126	.125	.124	.123	.122	.121
3-16	.003	.001	.189	.188	.187	.186	.185	.184
1-4	.003	.001	.251	.250	.249	.248	.247	.246
5-16	.005	.002	.315	.313	.311	.310	.308	.306
3-8	.005	.002	.377	.375	.373	.372	.370	.368
7-16	.005	.002	.440	.438	.436	.435	.433	.431
1-2	.005	.002	.502	.500	.498	.497	.495	.493
9-16	.008	.003	.566	.563	.560	.558	.555	.552
5-8	.008	.003	.628	.625	.622	.620	.617	.614
11-16	.008	.003	.691	.688	.685	.683	.680	.677
3-4	.008	.003	.753	.750	.747	.745	.742	.739
13-16	.008	.003	.816	.813	.810	.808	.805	.802
7-8	.008	.003	.878	.875	.872	.870	.867	.864
15-16	.008	.003	.941	.938	.935	.933	.930	.927
1	.008	.003	1.003	1.000	.997	.995	.992	.989
1 1-16	.010	.004	1.067	1.063	1.059	1.057	1.053	1.049
1 1-8	.010	.004	1.129	1.125	1.121	1.119	1.115	1.111
1 3-16	.010	.004	1.192	1.188	1.184	1.182	1.178	1.174
1 1-4	.010	.004	1.254	1.250	1.246	1.244	1.240	1.236
1 5-16	.010	.004	1.317	1.313	1.309	1.307	1.303	1.299
1 3-8	.010	.004	1.379	1.375	1.371	1.369	1.365	1.361
1 7-16	.010	.004	1.442	1.438	1.434	1.432	1.428	1.424
1 1-2	.010	.004	1.504	1.500	1.496	1.494	1.490	1.486
1 9-16	.010	.004	1.567	1.563	1.559	1.557	1.553	1.549
1 5 8	.010	.004	1.629	1.625	1.621	1.619	1.615	1.611
1 11-16	.010	.004	1.692	1.688	1.684	1.682	1.678	1.674
1 3-4	.010	.004	1.754	1.750	1.746	1.744	1.740	1.736
1 13-16	.010	.004	1.817	1.813	1.809	1.807	1.803	1.799
1 7-8	.010	.004	1.879	1.875	1.871	1.869	1.865	1.861
1 15-16	.010	.004	1.942	1.938	1.934	1.932	1.928	1.924
2	.010	.004	2.004	2.000	1.996	1.994	1.990	1.986

TABLE 1. LIMIT SIZES FOR GENERAL WORK.

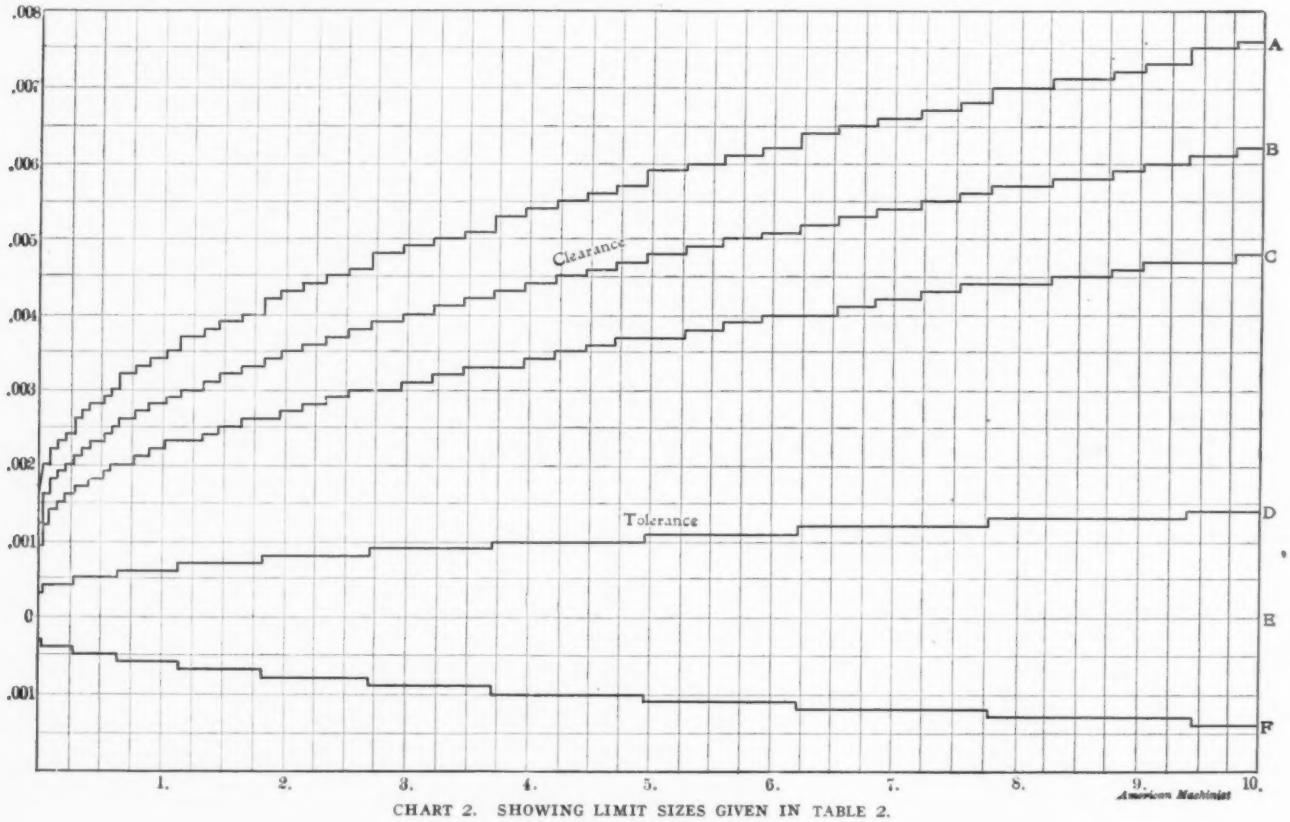


CHART 2. SHOWING LIMIT SIZES GIVEN IN TABLE 2.

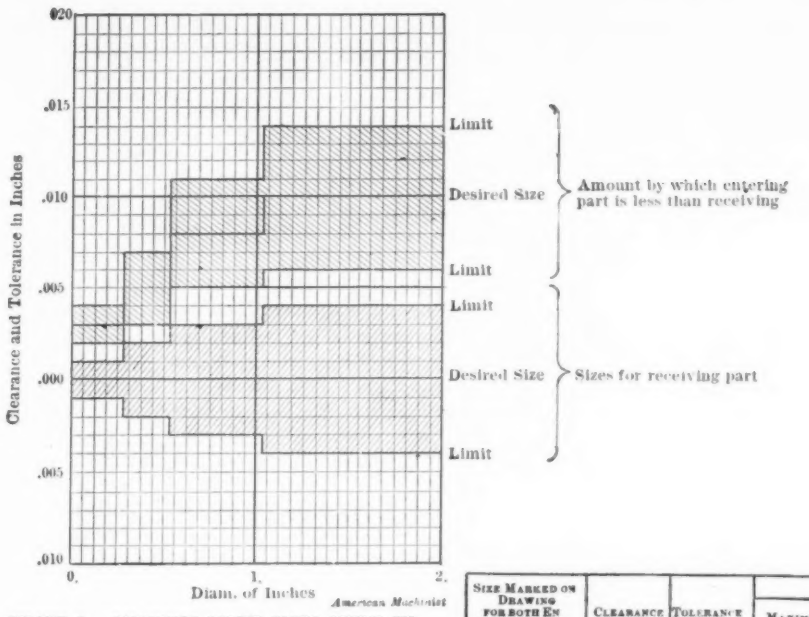


CHART 1. SHOWING LIMIT SIZES GIVEN IN TABLE 1.

This table gives considerably more freedom than that recommended by Henry Hess at page 73, Vol. 27. Chart No. 2 is a graphical representation of Table No. 2. Table No. 3 is for spring cotter holes.

The sizes given in these tables for entering parts are the sizes of the test tools as measured with a micrometer caliper or measuring machine. The tool must enter (or not enter) freely in the work without force. The sizes given for receiving parts are the sizes of entering parts which fit "nicely" in the receiving gages.

An engine driver on one of the lines of railway owned by the Russian Government refused recently in rather strong language to allow one of the higher officials connected with the line to ride on his engine without a ticket. The engine driver was dismissed from his post; thereupon he addressed a petition to the Tsar, and stated the cause of his dismissal. The matter was reopened and taken before the Ministry of Ways of Communication, which had to deplore the fact that the higher official did not observe the existing regulations, and that he failed to obtain the necessary ticket authorizing him to ride on the engines. The engine driver has been restored to his post.—*The Engineer.*

Nominal Size of Cotter	Size of Hole		
	Maximum Limit	Desired Size	Minimum Limit
1-16	.090	.085	.080
5-64	.110	.105	.100
3-32	.120	.115	.120
7-64	.130	.125	.120
1-8	.150	.145	.140
5-32	.180	.175	.170
3-16	.210	.205	.200
7-32	.250	.245	.240
1-4	.280	.275	.270
5-16	.340	.335	.330
3-8	.400	.395	.390

American Machinist

TABLE 3. FOR TESTING SPRING COTTER HOLES.

Monthly Meetings of the A. S. M. E. in New York.

The first of the monthly meetings of the American Society of Mechanical Engineers for the winter will be held in the society house, 12 West Thirty-first street, on Tuesday evening, January 31. Rear-Admiral George W. Melville, ex-president of the society, will address the members on "Epochs in Marine Engineering." The mere announcement must ensure a large attendance, and a more promising opening for the present series of meetings could not have been devised. Meetings will be held also on the last Tuesdays of February, March and April. The speaker for the next meeting is James M. Dodge, of Philadelphia, also an ex-president of the society. His topic is not announced. The meetings begin at 8.15 P. M.

Size Marked on Drawing for both Entering and Receiving Parts	Clearance	Tolerance	Receiving			Entering		
			Maximum Limit	Desired Size	Minimum Limit	Maximum Limit	Desired Size	Minimum Limit
.0000	.0012	.0003						
.0625	.0016	.0004	.0629	.0625	.0621	.0613	.0609	.0605
.125	.0018	.0004	.1254	.125	.1246	.1236	.1232	.1228
.1875	.0019	.0004	.1879	.1875	.1871	.1860	.1856	.1852
.25	.0020	.0004	.2504	.25	.2496	.2484	.2480	.2476
.3125	.0021	.0005	.3130	.3125	.3120	.3109	.3104	.3099
.375	.0022	.0005	.3755	.375	.3745	.3733	.3728	.3723
.4375	.0023	.0005	.4380	.4375	.4370	.4357	.4352	.4347
.5	.0023	.0005	.5005	.5	.4995	.4982	.4977	.4972
.5625	.0024	.0005	.5630	.5625	.5620	.5606	.5601	.5596
.625	.0025	.0005	.6255	.625	.6245	.6230	.6225	.6220
.6875	.0026	.0006	.6881	.6875	.6869	.6855	.6849	.6843
.75	.0026	.0006	.7506	.75	.7494	.7480	.7474	.7468
.8125	.0027	.0006	.8131	.8125	.8119	.8104	.8098	.8092
.875	.0027	.0006	.8756	.875	.8744	.8729	.8723	.8717
.9375	.0028	.0006	.9381	.9375	.9369	.9353	.9347	.9341
1.	.0028	.0006	1.0006	1.	.9994	.9978	.9972	.9966
1.0625	.0029	.0006	1.0631	1.0625	1.0619	1.0602	1.0596	1.0590
1.125	.0029	.0006	1.1256	1.125	1.1244	1.1227	1.1221	1.1215
1.1875	.0030	.0007	1.1882	1.1875	1.1868	1.1852	1.1845	1.1838
1.25	.0030	.0007	1.2507	1.25	1.2493	1.2477	1.2470	1.2463
1.3125	.0030	.0007	1.3132	1.3125	1.3118	1.3102	1.3095	1.3088
1.375	.0031	.0007	1.3757	1.375	1.3743	1.3726	1.3719	1.3712
1.4375	.0031	.0007	1.4382	1.4375	1.4368	1.4351	1.4344	1.4337
1.5	.0032	.0007	1.5007	1.5	1.4993	1.4975	1.4968	1.4961
1.5625	.0032	.0007	1.5632	1.5625	1.5618	1.5600	1.5593	1.5586
1.625	.0032	.0007	1.6257	1.625	1.6243	1.6225	1.6218	1.6211
1.6875	.0033	.0007	1.6882	1.6875	1.6868	1.6849	1.6842	1.6835
1.75	.0033	.0007	1.7507	1.75	1.7493	1.7474	1.7467	1.7460
1.8125	.0033	.0007	1.8132	1.8125	1.8118	1.8099	1.8092	1.8085
1.875	.0034	.0008	1.8758	1.875	1.8742	1.8724	1.8716	1.8708
1.9375	.0034	.0008	1.9383	1.9375	1.9367	1.9349	1.9341	1.9333
2.	.0035	.0008	2.0008	2.	1.9992	1.9973	1.9965	1.9957
2.0625	.0035	.0008	2.0633	2.0625	2.0617	2.0598	2.0590	2.0582
2.125	.0035	.0008	2.1258	2.125	2.1242	2.1223	2.1215	2.1207
2.1875	.0036	.0008	2.1883	2.1875	2.1867	2.1847	2.1839	2.1831
2.25	.0036	.0008	2.2508	2.25	2.2492	2.2472	2.2464	2.2456
2.3125	.0036	.0008	2.3133	2.3125	2.3117	2.3097	2.3089	2.3081
2.375	.0037	.0008	2.3758	2.375	2.3742	2.3721	2.3713	2.3705
2.4375	.0037	.0008	2.4383	2.4375	2.4367	2.4346	2.4338	2.4330
2.5	.0037	.0008	2.5008	2.5	2.4992	2.4971	2.4963	2.4955
2.5625	.0038	.0008	2.5633	2.5625	2.5617	2.5595	2.5587	2.5579
2.625	.0038	.0008	2.6258	2.625	2.6242	2.6220	2.6212	2.6204
2.6875	.0038	.0008	2.6883	2.6875	2.6867	2.6845	2.6837	2.6829
2.75	.0039	.0009	2.7509	2.75	2.7491	2.7470	2.7461	2.7452
2.8125	.0039	.0009	2.8134	2.8125	2.8116	2.8095	2.8086	2.8077
2.875	.0039	.0009	2.8759	2.875	2.8741	2.8720	2.8711	2.8702
2.9375	.0039	.0009	2.9384	2.9375	2.9366	2.9345	2.9336	2.9327

TABLE 2. LIMIT SIZES FOR ACCURATE INTERCHANGEABLE PARTS.

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Dissatisfied Exhibitors.

Rather sinister stories reach us regarding the difficulties that some exhibitors at St. Louis are experiencing in getting their goods away from the grounds. Not only is there much more delay than exhibitors think there should be, which of course is to be expected, but worse things are reported, arising apparently from the fact that there is a practical monopoly of the business of hauling goods out of the buildings, and this work is done under certain rules and regulations which may in some cases be very annoying if strictly enforced and which are very strictly enforced except where those who have the power to enforce them are in some way induced to relax their vigilance. Naturally, the form of inducement offered for such relaxation varies widely, depending upon the character of the person who wishes the goods removed and upon his urgency or the intensity of his desire to get the goods out and delivered to customers. So unpleasant has this experience been in some instances that it has produced a feeling of desperation upon the part of exhibitors, one important machinery exhibitor writing us: "Our experience at the St. Louis Fair, we assure you, has been very unsatisfactory; so much so, that we would not under any circumstances consider exhibiting at another fair or exposition for some time to come."

Just why our correspondent adds the words "for some time to come" we do not know; but as his concern is an incorporated one, perhaps he means that no proposition to exhibit will be considered during the lifetime of the present officers of the company. It remains true, however, that most exhibitors of machinery are dissatisfied with their experiences at exhibitions and the majority of them take more or less solemn and variously emphasized vows that they will never, never, be caught exhibiting again. Some of them stick to their vows, but most of them are persuaded to try it once more, with the result that there is a new and stronger crop of vows. At any rate, we feel quite confident that anyone who should now or soon attempt to enlist the co-operation of American tool builders in an exhibition would have a pretty hard row to hoe.

Cost Accounting in Government Work.

It is claimed that the battleship "Connecticut," which is being built at the New York navy yard, is costing and will cost much less than a similar ship being built at Newport News, and some conclusions are being drawn from this which perhaps would not stand close scrutiny. We know that special and very creditable efforts are being made to build the "Connecticut" at a cost which will compare favorably with the cost of vessels built in private yards, but before anyone familiar with manufacturing operations and cost accounting will accept statements bearing upon comparative costs he will need to know a good deal about how those costs are computed. When the owner of a private shipyard needs new tools or to make any improvements about his plant, he has to go down into his own strong box for the money. And unless there has been profit enough in previously completed jobs to afford some margin for supplying the said strong box he must go to "financiers" for capital and must in some form or other pay a smashing premium for it. How different with the government yards! Congress is asked to "make an appropriation"; it makes it and that is the end of it. True, costs can be so calculated by navy yard officials as to cover all this, but are they? We do not pretend to say that they are not, but it does look as tho the tremendous difference in the cost of the two vessels referred to, one of which is being constructed under a contract awarded as a result of what is generally understood to be free competition can be accounted for only on the theory that methods of cost accounting widely differ. It is also true that very often what appears to be free competition turns out to be something entirely different when inside affairs are brought to light. We would suggest that when the question of determining whether or not vessels should be built in private yards is brought up before Congress, a disinterested expert cost-accountant familiar with costing manufacturing operations be appointed to examine into the methods followed in the navy yards and report upon his findings. It is probable that the naval officers concerned would welcome such an examination, for they can have no other object than to know where they stand and to have all others know the actual facts.

How Profitable are Toolrooms?

One of the things which it seems likely must be taken for granted more or less by machine-shop proprietors generally is as to the amount of advantage to be gained from the establishment and maintenance of toolrooms and toolroom systems. While we all think we know and feel very confident that tooolrooms are a very great advantage, yet it seems impossible to get any definite figures to show just how profitable toolrooms are, or, in fact, to be able to actually prove that they are any profit whatever.

Recently a manufacturing firm had occasion to investigate this matter and wished to get precise knowledge regarding it. We co-operated in the effort to obtain such information and corresponded with shop proprietors here and in foreign countries, with the result that we were unable to get any definite information whatever.

One of the difficulties in the way of getting such information is the fact that in most cases where toolrooms have been established the comparisons of cost as between a toolroomless condition and one in which the toolroom is in full use are impossible, for the reason that when a firm puts in a toolroom it usually introduces

other changes in its method of carrying on the business and doing its work which also vitally affect the cost of production, and these other changes obscure the economies that result from the establishment of the toolroom, making it impossible to determine just what effect the toolroom by itself has, as compared with an entire absence of system in the care of and repair of tools.

There is probably no other feature of modern manufacturing processes about which manufacturers feel so sure they are right as they do about the maintenance of toolrooms, but which at the same time affords so little opportunity for getting precise definite information as to just how much advantage it may be.

Inability to obtain precise information regarding this will not, of course, discourage those who are accustomed to toolrooms and know the value of them; they will continue to be very confident that toolrooms are an indispensable feature of modern and efficient manufacturing operations. But in the meantime, if any of our readers are in position to give us definite information regarding the advantages in dollars and cents or in pounds sterling to be obtained by the establishment and maintenance of toolrooms, we shall be very glad to get hold of the information; we think it would be of interest to very many of our readers here and abroad, and would probably tend strongly toward the establishment of more toolrooms, and perhaps toward the better maintenance of some of those that have been already established.

To those investors who possess a maximum of cash and a minimum of brains the Mite-e-motor displayed (not described) in the *Montreal Daily Star* of November 5, 1904, presents many allurements. It will run anything from a toy boat to a battleship, etc., etc. The "description," which we quote herewith, is remarkable for its comprehensiveness:

"The Mite-e-motor Described. The Mite-e-motor is a turbine, the power being generated by the use of air compressed to a high compression pressure, increased in volume or swollen in quantity by the direct application of heat." A 20 horse-power Mite-e-motor, "absolutely self-contained," occupies but 18x8 inches. The third dimension is not given. We assume that the "high compression pressure" is also within the small space mentioned. "The Mite-e-motor is so designed that the moving parts, which consist of the rotors and shafts, are all rotating and reduced to a minimum." A limited number of shares are offered at par, $5 each. Of course the price will shortly be advanced.

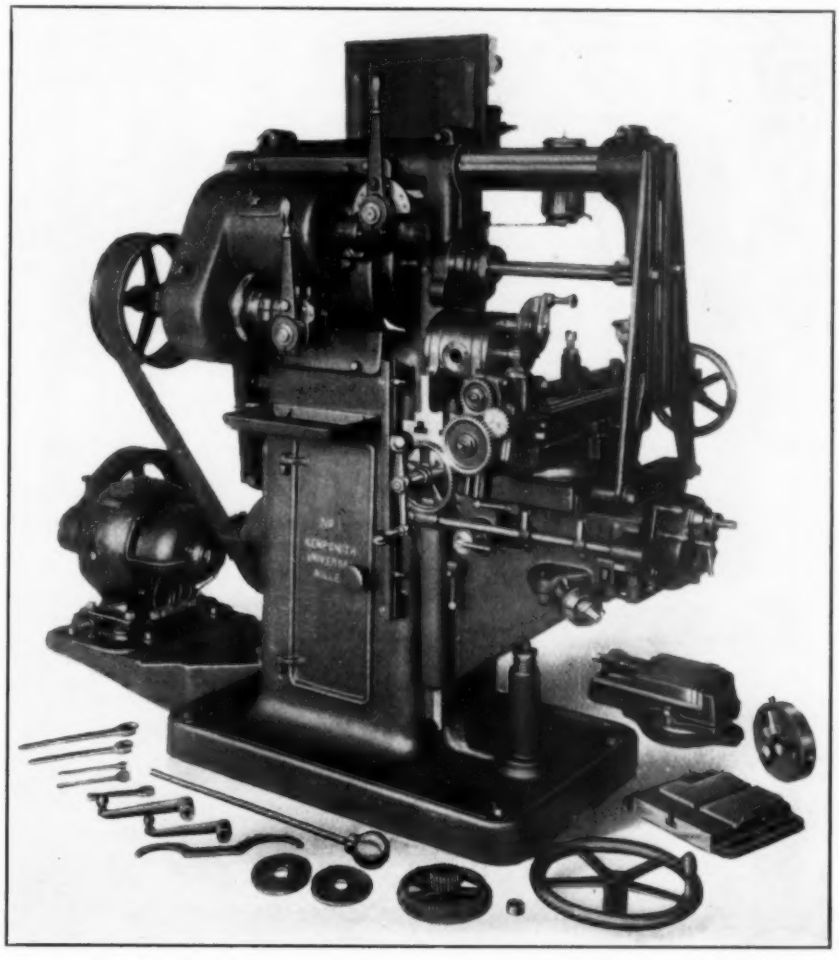
Sixty thousand dollars in gold was divided among the 4,000 employees of the Boston Elevated Railway Company at Christmas, each employee getting $15. There was a similar distribution a year ago.

New Tools and Machine Shop Appliances.

MOTOR-DRIVEN UNIVERSAL MILLING MACHINE.

The accompanying illustration shows the latest "Kempsmith" universal milling machine, equipped with motor drive, designed and built by the Kempsmith Manufacturing Company, Milwaukee, Wis. The 1½ horse-power constant-speed motor is of the back-gear type, and is mounted on a stand which is bolted to the main machine casting. The back-gear shaft of the motor is connected to the driving shaft of the machine by a wide belt (or it can be connected by silent chain). The variable-speed mechanism on the miller provides a range of sixteen changes obtained thru ring frictions, this method being of advantage in that it permits the combination for any desired speed being thrown in while the machine is running, without interfering with its operation in the slightest. The various changes are obtained thru levers located at the front of the mechanism within easy reach of the operator. A speed plate is placed on the machine, giving the full range of speeds and how to obtain them. The entire mechanism is covered, and has ample facilities for oiling all working parts. The starting box is mounted above the machine, where it is out of the way, and yet with switch and starting box levers within easy reach of the operator. This method of motor drive may be applied to the machine at any time after its completion, or it may be incorporated in the machine while building, in which case the builders are able to render the construction somewhat more compact in appearance.

All feeds to the table are positive and automatic. The geared feed changing mechanism is simple and powerful. The gear box is recessed into the column, thus being supported without any overhang. It is driven by sprocket chain direct from the spindle, the sprocket wheel being keyed to the main spindle. Thru the levers shown on the gear box, sixteen changes of feed are available in geometrical progression, the range being selected for greatest efficiency in ordinary milling. An index plate on the front of the box shows the entire range and the necessary combination to obtain any desired feed. The levers for reversing all feeds and for automatically tripping all feeds at any time are centrally located at the front of the knee, so that the operator has all the movements of the machine under his immediate control without change of position. The

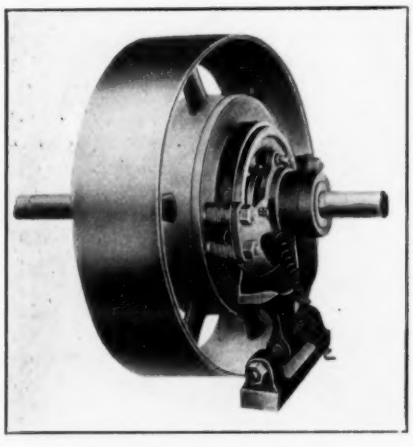


MOTOR-DRIVEN UNIVERSAL MILLING MACHINE.

column, base and bridge for overhanging arm are cast in one piece, ribbed internally, the internal ribs serving the double purpose of tie plates for the sides of the column, and a series of handy shelves. The swiveling table on the universal miller shown in the illustration is easily clamped at any position by a beveled clamping ring. The universal dividing head is simple and compact. The tailstock center can be elevated for milling tapers. The telescopic elevating screw permits the table to travel to its lowest point without requiring a hole in the floor or foundation.

ELECTRICALLY OPERATED CLUTCH AND SAFETY STOP.

The accompanying illustration shows an electrically operated clutch which may be operated in combination with a safety stop to shut down machinery in case of accident, the stopping and starting being either gradual or instantaneous as desired. Pushbuttons or switches may be located at such points as desired, and when used as a safety stop an annunciator



ELECTRICALLY OPERATED CLUTCH.

may be located in the superintendent's office or elsewhere to indicate the point at which an accident has occurred. Used as a clutch in connection with machine tools the pushbutton may be located on the lathe carriage or at any other convenient point. The machine is made by the Williams Electric Machine Company, of Akron, Ohio.

NEW HAND PUNCHES AND SHEARS.

The half-tones show some samples of an interesting line of punches and shears now being brought out by the Buffalo Forge Company, Buffalo, N. Y. One noticeable and important feature of these tools is the use of armor plate steel instead of the usual frame of gray iron, thus securing lightness, accessibility of parts, strength and reliability under the most exacting work.

BUFFALO SLITTING SHEAR.

This shear, Fig. 1, has been designed especially for the sheet metal worker. The work clears the jaws and the body of the shear, so that sheets of any width may be sheared in successive cuts. The lever which is inserted in the socket to operate the shear is not shown. The shear will cut ¼-inch iron, the hight of the jaws being 30 inches from the floor. It may be taken off the stand and fastened upon the bench. The weight of the shear as shown is 220 pounds.

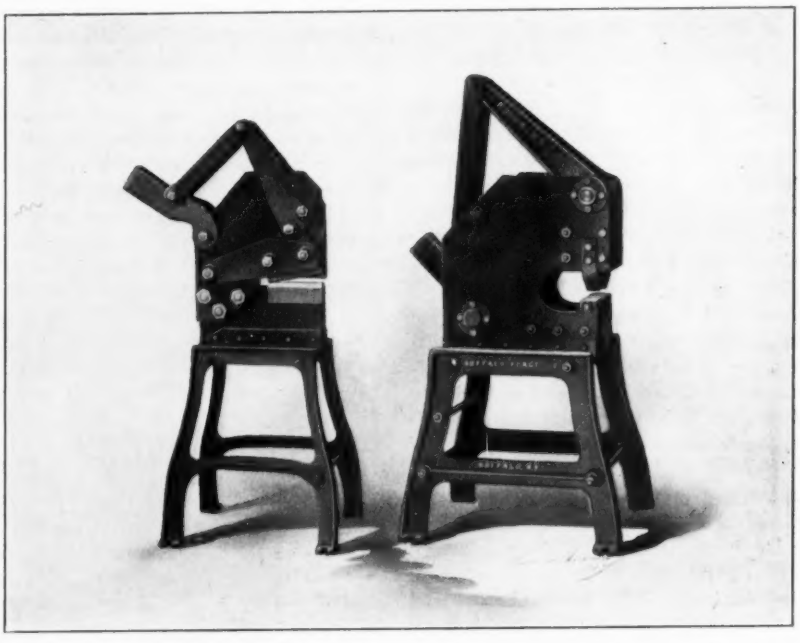


FIG. 1. BUFFALO SLITTING SHEAR.

FIG. 2. BUFFALO PLATE FRAME PUNCH.

BUFFALO PLATE FRAME PUNCH.

The punch, Fig. 2, is made in three sizes, the largest being here shown. It will punch ½-inch holes thru ½-inch plate. The depth of the throat is 5½ inches, and the weight is 320 pounds. Two sockets for the lever are provided, thus permitting the application of the power in the most convenient and effective position. The steel frame shows a decided contrast to the usual heavy and inconvenient cast frames which have been so generally employed.

BUFFALO COMBINED PUNCH AND SHEAR.

This tool, Fig. 3, seems to be a marvel of simplicity in design. The frame or body of the machine is a single plate of armor steel, the manner in which the working parts are attached requiring no explanation. It is adapted for general blacksmithing and light structural work, punching ⅜-inch holes in ⅜-inch stock to the center of an 8½-inch circle, and shearing up to ⅜x2½-inch bars. The total weight of the tool as shown is 155 pounds. The punch plunger is operated

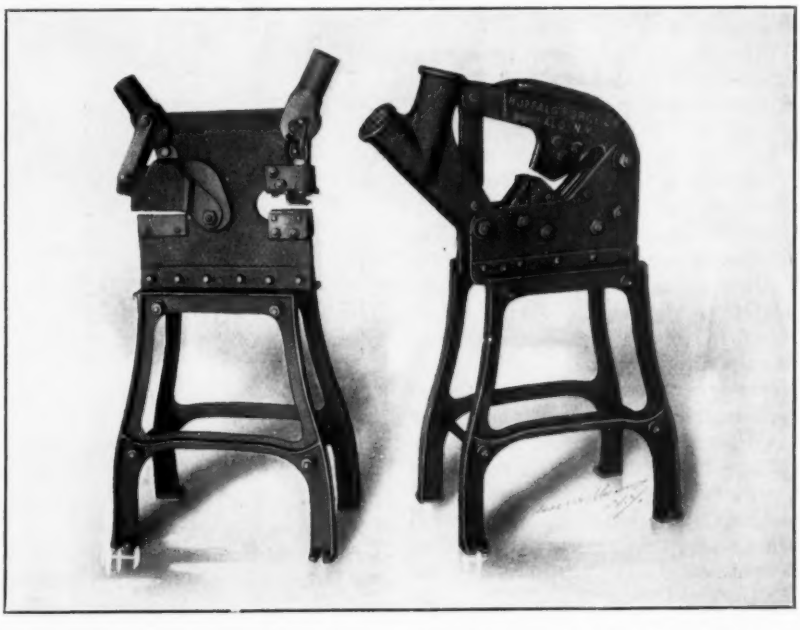


FIG. 3. COMBINED PUNCH AND SHEAR.

FIG. 4. BUFFALO ANGLE IRON SHEAR.

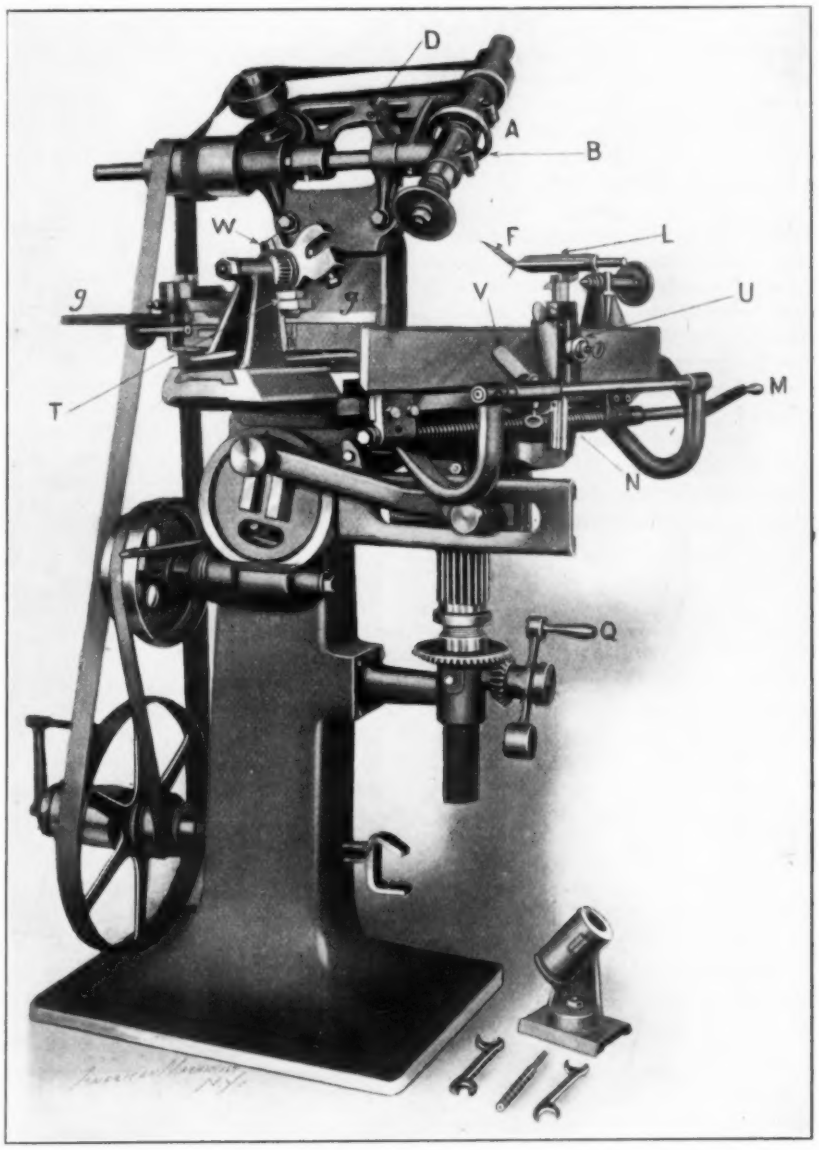
by a cam and roller combination, and the shear by compound levers, as used in the other tools here shown. The jaws of the shears are of tool steel and heavy enough to prevent twisting or warping under heavy work.

BUFFALO ANGLE-IRON SHEAR.

The angle-iron cutter, Fig. 4, readily cuts up to 2½x2½x¼ inch, iron or steel, leaving no ragged edges. Its use admits of quite accurate work, giving as clean and square a cut as a hack saw. The hight over all is 36 inches, and the weight 150 pounds.

AUTOMATIC CUTTER GRINDER.

This grinder has, besides the table and rotary feed, several novel features, the most important being the swivel head *A* that carries the spindle. This has the four-wheel drive, which allows the spindle to be fixed at any angle with the cutter from 0 to 90 degrees or more. Of course, the change can be made while the machine is in motion, a suitable clamp being provided at *D*. This spindle head has also a lateral adjustment of 3 or more inches, bringing the wheel nearer to the centers. To elevate or lower the bed for different diameters of cutters, the crank *Q* and the bevel wheels are used, but for fine setting the threaded hand-wheel *B* fitted to the quill that carries the spindle thru the head *A* answers the purpose, the hub of the wheel having the usual graduations for fine adjustment. The table feed on this machine is by crank, rack and pinion, worm wheel and screw rack *N*. The screw (engaging with the worm wheel under the table) serves the purpose of a rack, also answering for a hand feed when required, altho the main object of using a screw rack is to be able to change the relative position of the cutter and the wheel during the travel of the table in order to bring the cutter in the right position to be ground. The rotary feed is thru the pawl *F*, roll *U* and incline *V*. The pawl gets its motion thru the roll *U* riding the incline *V*; this imparts a vertical movement to an upright bar in the pawl head; this bar, having an angle end, comes in contact with a small roll located in the pawl bar within the socket *L*; thus the vertical motion in the upright bar gives lateral movement to the pawl *F*, which can be varied by changing the angle of the incline *V*. The pawl *F*, as seen in the cut, is locked up out of working position for clearance, but can be snapped down on to cutter by slight pressure. It is then fixed to feed a cutter from the top, but it is necessary sometimes to feed a cutter from the side when set vertically. In this case the pawl is placed around quarter way on either side of the cutter. It is often required to feed a tooth a little farther around, or not so far. Provision is made for this in the nurled nut at the end of the pawl bar whereby the pawl bar is lengthened or shortened without affecting the feed. The small projection seen below the pawl is called a trip piece; this is used when grinding spiral cutters only; when grinding straight cutters the pawl rests lightly on the cutter teeth, and for every travel of bed one tooth is fed; thus each tooth passes under the wheel twice. Now, in case of a spiral cutter, the pitch being less than the spiral, if the pawl rested upon the teeth in the rotation of the cutter, the pawl would catch the wrong tooth. This would take place soon after the table commenced its return trip; hence the necessity of the trip piece. A pin projecting from the pawl bears on this trip piece and on the forward movement of pawl; this pin follows down the incline of the trip, allowing the pawl to engage with the proper tooth in the right time to make the feed. The spiral motion to the cutter is made thru the angle-bar *g g* and a rack *T* and pinion *W*, the end of rack having a gibbed head that slides on the bar *g g*. This bar is mounted on a turntable with worm tooth on one end, in which the worm under the bar meshes, and by this means the bar *g g* is set at any angle with the travel of the bed, this giving reciprocating motion to the rack and rotary motion to the pinion *W*, and as the carrier plate is journaled on the hub of the pinion, of course, when the pinion turns the cutter turns with it to the extent of the spiral required, let it be more or less. The carrier plate is held to the hub of the pinion by friction only, which can be increased by the clamp screw in the back of the plate sufficient to meet all requirements, and is only overcome when the pawl acts on a tooth to make a feed. The bed can be turned on its center from zero to 90 degrees. This machine takes 26 inches between centers by 11 inches, and grinds automatically 12x11 inches, and by using the hand feed *M* cutters 16x11 inches can be ground. It is made by the F. Gleason Machine Works, Olney, Pa.



AUTOMATIC CUTTER GRINDER.

The word "germ" is getting to be the bogey-man of grown-up children.

Comparative Test of a Small Boring Mill With and Without Maintained Cutting Speed.

The test recorded below of a 31-inch boring mill equipped with the new Rheocrat Controller of the American Electric & Controller Company, which was illustrated at page 1687, Vol. 27, was made recently at the office of the company, 12 Dey street, New York. The boring mill was a modern tool having a single pulley drive and a four-change-gear speed box and was driven by an ordinary shunt-wound constant-speed motor of 5 horsepower capacity, the addition of the Rheocrat converting it into a mill having upward of 144 changes of speed. The actual range of the motor speeds obtained by the controller, being slightly over 4 to 1, enabled any single piece of work to be faced from the perifery to almost the center at practically a constant rate of cutting speed, the mechanical changes of the boring mill being used merely to adjust the work to the proper speed at the outset of the operation.

The accompanying table of speeds is given with the purpose of showing the relation of speeds obtained by mechanical means (thru the gear box) to the range of speeds obtained by the Rheocrat, the former being designated mechanical and the latter electrical changes.

MECHANICAL CHANGES.

(Driving shaft running 270 R. P. M.)

	Turns of table per minute.
Back gears (4½ to 1) in:	
First gear	3.6
Second gear	5.4
Third gear	7.2
Fourth gear	10.8
Back gears out:	
First gear	16.2
Second gear	24.25
Third gear	32.4
Fourth gear	48.6

One-quarter minute required to make any one of the above changes.

ELECTRICAL CHANGES.

(Driving shaft running 112 to 450 R. P. M.)

	Turns of table per minute
Back gears (4½ to 1) in:	
First gear	1.5 to 6
Second gear	2.25 to 9
Third gear	3 to 12
Fourth gear	4.5 to 18
Back gears out:	
First gear	6.75 to 27
Second gear	10.1 to 40.5
Third gear	13.5 to 54
Fourth gear	20.2 to 81

No measurable time lost making changes.

The following figures were obtained from an actual test made on a 12-inch pipe flange 25 inches outside diameter, "A. W." steel being used, the grade of iron being such that 150 feet per minute cutting speed was found to be the maximum that this steel would stand. The object of the test was to keep the cutting rate as near as possible to this maximum.

In order to finish the flange two cuts, a roughing and finishing, had to be taken:

CASE 1.

Mill operated by motor without the use of the Rheocrat.—Shaft running at constant speed 270 R. P. M. Back gears out. Speed changes made by shifting the quick change gears in the speed box. Maximum cutting speed, 150 feet per minute; highest average possible, 127 feet per minute; actual time of cutting, 3.9 minutes; time lost in changing gears, 1.2 minutes for roughing cut; time lost in reversing feed, .5 minute; total time required to make the two cuts, 10.7 minutes; time lost in taking out work and resetting another casting, about 5 minutes, or a total of 15.7 minutes to face a flange.

CASE 2.

Mill operated by motor without the use of Rheocrat.—Shaft running at constant speed, 270 R. P. M. Back gears out. No changes were made in the gearing on the supposition that the average shop mechanic would not make them. Maximum cutting speed, 150 feet per minute; highest average possible, 79.11 per minute; actual time of cutting, 6.35 minutes for one cut; time lost in reversing feed, .5 minute; total time required to make the two cuts, 13.2 minutes; time lost in taking out work and resetting another casting, about 5 minutes, or a total of 18.2 minutes to face the flange.

CASE 3.

Mill operated by motor and Rheocrat, securing a range on the driving shaft from 112 to 450 R. P. M. Back gears out. Machine adjusted to the proper speed by combined Rheocrat and change gear variation but Rheocrat variation alone used during cut. Maximum cutting speed, 150 feet per minute; highest average possible, 146 feet per minute; actual time of cut, 3.45 minutes; time lost in changing speeds, none; total time, 3.45 plus .5 minute for reversing feed equal 3.95 minutes; time for two cuts, 7.4 minutes; time lost in taking out work and resetting another casting, about 5 minutes; total, 12.4 to face each flange.

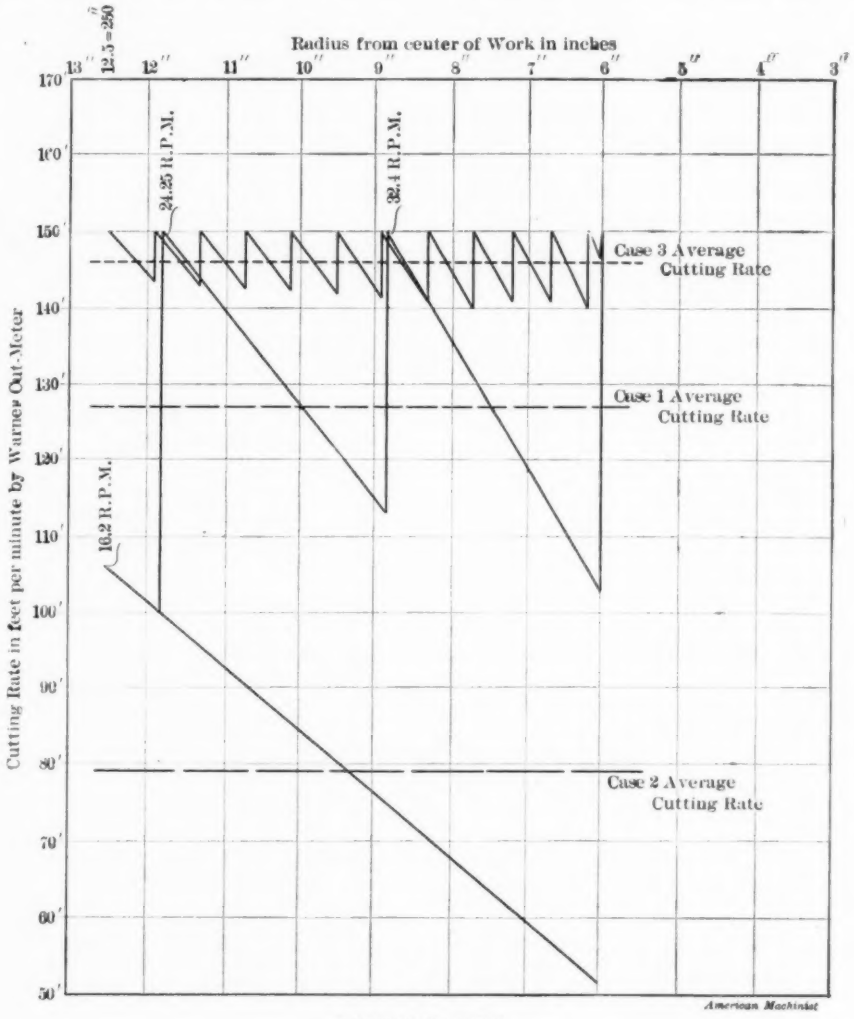


DIAGRAM OF TESTS.

The above cases are shown graphically in the three curves shown in the diagram.

Comparing case 1 with case 3 and allowing an aggregate of eight continuous working hours, the daily output would be thirty flanges in case 1 and thirty-eight flanges in case 3, which shows a gain of practically 28 per cent. output. Assuming in case 1 that the cost to face each flange was 10

cents, in case 3 the cost would be less than 8 cents.

Comparing case 2 with case 3 and allowing the same number of hours per day, the daily output in case 2 would be twenty-seven flanges, in case 3 thirty-eight flanges, which is a gain of more than 40 per cent. Assuming that in case 2 the cost of each flange was 11 cents, in case 3 the cost would be less than 8 cents each.

The January Meeting of the Milwaukee Branch of the A. S. M. E.

EDITORIAL CORRESPONDENCE.

An extremely interesting and well attended meeting of this new organization was held at the Hotel Phister the evening of January 17. The principal business of the evening was an account by Professor W. S. Johnson, of the Johnson Temperature Regulating Company, of the results of his three years of work in developing steam-driven automobile trucks. This account he prefaced with some striking statements of the difference in conditions which surround the business and pleasure automobile—the former being by far the more difficult.

The owner of a pleasure vehicle will tolerate many things which would condemn a business vehicle at once. If a pleasure vehicle breaks down, the owner suspends its use until it is put in order, while reliability is the first requirement in a business vehicle. Even without suspension of its use a pleasure vehicle is in use but a small part of the time, giving ample opportunities for repairs, while a business vehicle must be in constant use. The owner of a pleasure vehicle makes no comparison of the cost of operating it with horse-drawn carriages, while the business vehicle to be successful at all must compete with horse traction. The owner of a pleasure vehicle employs a skilled and well-paid chauffeur to operate and care for it, while the business truck must be capable of operation by much cheaper men. In operating conditions we find the same contrast, for, while the pleasure vehicle is of comparatively light weight and moves at high velocity, exactly the opposite conditions obtain with business vehicles.

The speaker had had exceptional opportunities for observing the use of automobile trucks in London and Paris. In the former city are a good many steam trucks which are fired with coke because of the absence of smokeless coal in England. The trucks are very strong and heavy and of slow speed. They carry loads of from four tons upward at speeds of from three to six miles per hour. They are used but five days a week, Saturday being universally used as a day for overhauling and making repairs. Distances up to forty miles a day are made by a single truck. Many traction engines with trains of wagons are also used. An immense field for automobiles is presented by the use of omnibuses in London, and experiments in this direction are now being made. In Paris he had seen one gasoline truck in the streets, which was in trouble when he saw it, and he had seen several others at an automobile show. In New York many electric but no steam trucks are in use.

At the beginning of his work he had adopted steam as the means of propulsion and had made in all five machines, one of which is in the scrap heap, while the others are fit for use. He began by buying all the fittings which it was possible to obtain in the market and had concluded by buying nothing but making everything. He applied the power to the front wheels because of the greater effect of the tractive force in turning curves. With the power thus located it is possible to start the truck with the front wheels slewed at a right angle and thus, under difficult conditions, start the load one-half at a time. Under the conditions named rear driving would not start the load at all, and with rear driving the load must all be started at once. The capacity to make short turns due to front driving also greatly increases the maneuvering power. Hand steering is entirely practicable with light vehicles, but with loads of four tons and upward the power required is so great as to involve so great a reduction by gearing as to seriously interfere with quick maneuvering, and such vehicles must be steered by power.

Gasoline as a fuel is inadmissable in a business vehicle. Should a gasoline pleasure vehicle take fire the passengers may alight from it, but such a happening with a business vehicle would destroy the load. After experimenting with coal he had adopted kerosene. After these preliminary remarks Professor Johnson described his vehicle, which is a novelty at every point of its motive power. He concluded by saying that if it did not prove successful he could do no more.

Mr. H. T. Hanson then took the floor and described the four-wheel-drive truck with which he is associated. In this machine all four wheels are at once driving and steering wheels. It is not tied up to any source of power, but is equally adapted to all. He pointed out another difference between business and pleasure vehicles, in that, while the latter naturally selected the good roads, the former must go on all kinds.

F. A. H.

New Publications.

"Das Skizzieren ohne und Nach Modell fuer Maschinenbauer. Ein Lehr- und Aufgabenbuch fuer den Unterricht." By Karl Keiser, instructor in drawing at the public trade school at Leipsic. 6x9 inches, with 24 figures and 23 tables. Berlin: Julius Springer, Monbijouplatz, 3. Price 3 marks.

This little book is an outgrowth of the experience of the author in meeting the requirements of the school with which he is connected for a systematic course of instruction in free-hand mechanical drawing without models. While free-hand drawing with models is also considered, it is treated as briefly as possible and partly with a view to correcting prevalent errors in the perspective representation of circles. The tables are filled with drawings of geometrical figures and machine details.

"Small Electrical Measuring Instruments." 90 5x7-inch pages, with 59 illustrations. The Model Engineer Series No. 24. Percival Marshall & Co., London. Price 6 pence.

The subject of this little pamphlet is sufficiently indicated by its title. It is intended to explain how to make as well as use the various instruments, and includes the chief ones used in electrical testing.

Marshall Halstead, our Consul at Birmingham, reports that an arsenal or rifle factory for the Indian Government, capable of making 30,000 rifles per year, is to be established at Ishpur.

The subject of steam turbines will be discussed, January 26, at a meeting of the Franklin Institute. Prominent men will participate, including Rear-Admiral Melville.

Personal.

J. G. Robertson has been appointed the New York agent of A. L. Ide & Son, and will have an office at 11 Broadway.

Achibald B. Bush has been placed in charge of the New York office of The Hisey-Wolf Machine Company, of Cincinnati, Ohio, the office of Mr. Bush being at 120 Liberty street.

Charles E. Paul, who has been assistant professor of mechanical engineering in the Kansas State Agricultural College, has been made head of the mechanical engineering department at the New Mexico College of Agriculture and Mechanic Arts at Las Cruces, N. Mex.

Obituary.

C. S. Bell, a past president of the American Foundrymen's Association, and head of the C. S. Bell Company, Hillsboro, Ohio, died January 3, seventy-five years old. He was a native of Maryland and learned the machinist trade in Pittsburg. He started a foundry at Hillsboro in 1858 which has grown into a large concern, with bells and cane mills as specialties.

Hugh Caskey, a retired brass and iron founder, died in Philadelphia, January 17, sixty years old. He was born in Philadelphia, served an apprenticeship in a brass foundry, was an assistant engineer in the navy during the Civil War, and in 1884 started a brass foundry in Philadelphia. In 1892 he founded, at Newport News, the H. & W. Caskey Brass & Iron Works, now consolidated with the Newport News Shipbuilding Company. He retired from business five years ago.

William Barnet Le Van, the well-known

consulting engineer and steam specialist, died at Newark, N. J., January 7. He was a native of Pennsylvania and lived for many years in Philadelphia. He was a life member of the Franklin Institute and was for many years a member of and a contributor to the transactions of the American Society of Mechanical Engineers. He was the author of "The Steam Engine and the Indicator," "The Practical Management of Engines and Boilers" and other works.

Business Items.

The R. D. Nuttall Company, Pittsburg, Pa., has appointed the Charles N. Wood Electric Co., 246 Summer street, Boston, Mass., as its agent for the sale of Nuttall material in the New England States.

A. L. Ide & Sons, Springfield, Ill., builders of Ideal engines, have established a New York office at 11 Broadway, thru which all export, New England and Middle States business will be transacted hereafter, under the management of Mr. J. G. Robertson.

Henry G. Mortimer, Jr., of the General Electric Inspection Company, has joined the New York office staff of the Crocker-Wheeler Company. He will assist F. B. De Gress, manager of that office, and will succeed A. J. Thompson, who has accepted a position with the New York branch of the Bullock Electric Manufacturing Company.

The Atlas Portland Cement Company has awarded a contract to the C & C Electric Company for a number of motors to be installed at its Hannibal, Mo., works. There will be forty-five machines in all, the total horse-power being 860. These motors will drive cement machinery; twenty-eight of them will be of variable speed, obtained by field control; voltage will be 500.

The Westinghouse Electric & Manufacturing Company has received an order thru its agents, Takata & Co., of Tokio, for thirteen direct-current generators, each of 62.5 kilowatts capacity, and thirteen spare armatures. Each generator will be driven by a 125 horse-power steam engine, supplied by the Westinghouse Machine Company. The Westinghouse Electric & Manufacturing Company has sold to the International Paper Company for use in its plant at Berlin, N. H., one 250-kilowatt, alternating-current generator of the revolving-armature type; three 40 horse-power alternating-current motors, with switchboard, transformers, etc. The Westinghouse Company has also sold to the Detroit United Railway Company, of Detroit, Mich., a 1,500-kilowatt railway generator and a 250-kilowatt booster set. Other street railway contracts just closed include fifty-four motor car equipments, to be used by the Cleveland Electric Railway Company, of Cleveland, Ohio, for city and suburban service. The motors will be of the new Westinghouse type, No. 101-B.

Manufacturers.

A brickyard will be established at Trenton, Me., by Alonzo Grindle and Capt. Fred Murch, of that town.

The Eagle & Phenix (Cotton) Mills, Columbus, Ga., propose to spend $40,000 for new machinery.

The National Machine Works, Chicago, Ill., has been destroyed by fire. The loss is estimated at $70,000.

Davenport (Iowa) Sugar Company has been incorporated, with $600,000, to build a beet sugar factory.

Contracts have been let for a new testing building for the Ford Motor Company, automobiles, Detroit, Mich.

The Central Iron Works, Syracuse, N. Y., will build a new plant costing about $50,000; Chas. E. Colton, architect.

It is rumored that a new foundry will be installed at the Harlan & Hollingsworth Company, at Wilmington, Del.

The Geo. R. Rich Manufacturing Company has moved its factory and offices from Chicago, Ill., to Buchanan, Mich.

The Streator (Ill.) Metal Stamping Company has increased its capital stock, and new machinery will be purchased.

The Driggs-Seabury Ordnance Corporation, Sharon, Pa., has decided to again enlarge its works, which are now building.

Two new packing houses will be built at the Chicago stock yards. Architect Zachery T. Davis has plans under way.

Fire broke out in the plant of the Farr & Bailey Oil Cloth Company, Camden, N. J., and did damage estimated at $80,000.

Klauber-Wangenheim Company, San Diego, Cal., has taken out a permit to construct a machine shop at a cost of $5,000.

A building permit has been issued for a $20,000 factory for J. C. Widman & Co., furniture and fixtures, Detroit, Mich.

F. H. Davis is about ready to go ahead on the addition to his machinery factory on Crescent avenue, Cambridge, Mass.

Plans have been prepared for an addition to the factory of the Forrester-Nace Box Factory Company, Kansas City, Mo.

The West Chester (Pa.) Cold Storage & Ice Company will enlarge its plant.

The I. X. L. & Goshen Pump Company, Goshen, Ind., is intending to enlarge its plant.

The Tallapoosa (Ala.) Water Power & Electric Company is being incorporated and proposes to erect a $500,000 power plant.

The plant of the St. Louis Plate Glass Company at Valley Park, twenty miles west of St. Louis, Mo., has been damaged by fire.

Houston, Tex., is to have a new rice mill, which will cost over $60,000. A company has been formed with W. O. Newhaus as president.

Henry M. Whitney, of Boston, and others have leased a manufacturing plant at Nashua Junction, N. H., and will establish an asbestos plant.

The Marysville (Ohio) Engineering Company has been organized and will make a specialty of machine work, automobile repairs, etc.

Archibald Paul Gerhardt, Chicago, is preparing plans for a machinery factory to be built on the west side. It will be four stories, 75x150 feet.

Owing to increasing business the Marion (Ind.) Pulp & Paper Company will increase the capacity of its plant by installing some more machinery.

The Keehn-Hoffner Printing Company, Burlington, O., will locate in a new building and enlarge its plant, putting in several new presses and other equipment.

Chas. C. Wilson, engineer, Columbia, S. C., states that bids will be received about February 15 for water-works and an electric light plant for Clinton, S. C.

Plans have been filed for a 90x74-foot factory. The owners are Ravitch Bros. & Heyman, of 81 Mangan street, New York city, who, we understand, are ironworkers.

The G. & D. Manufacturing Company, Streator, Ill., has been incorporated and will erect some new buildings, in which, after completion, they will install a lot of new machinery.

The Virginia Woolen Mills, of Winchester, Va., which recently resumed operations after a $40,000 fire last summer, has decided to double its capacity and install $40,000 worth of new machinery in addition to new buildings.

G. Eames, a manufacturer of machinery, is fitting up the old "Drill Grinder" shop at Kalamazoo, Mich., to manufacture a new variable-speed countershaft and other machinery.

A deal is on thru the Chamber of Commerce, Macon, Ga., for a tract of kaolin property. The prospective purchaser plans to establish a crockeryware manufacturing plant there.

The Waco (Ky.) Mining & Manufacturing Company maker of brick, tile, etc., has passed into new control, and it is proposed to build a new $150,000 plant. The main office will be in Lexington, Ky.

D. Ewart, chief architect of the Canadian public works department, has gone to the United States to examine the mint, preparatory to preparation of new plans for the royal mint at Ottawa.

The Goodell Tool Company, Shelburne Falls, Mass., has nearly completed moving from its old quarters in the factory of the H. H. Mayhew Company to its new plant, formerly the peg shop.

The Paducah (Ky.) Mattress & Awning Company, at 215 South Third street, is moving to a new factory at Third and Ohio streets. The factory will be enlarged and modern machinery added.

The Monroe (Mich.) Marble & Granite Works Company will start work in the spring to double the size of its present plant, as well as double the output. New automatic machinery will be installed.

Business men of Glenwood Springs, Colo., have organized the Three Rivers Beet Sugar Factory Promotion Company. W. F. Parkinson is president; Geo. H. Bell, secretary. O. W. Daggett is the promoter.

The Rowe Knitting Company, Huntsville, Ala., after holding its annual meeting, decided to increase the capacity of the mill 50 per cent. by the addition of new machinery and the erection of another building.

Charles Kirkham, Taggart, N. Y., manufacturer of the Kirkham motor, has succeeded in raising capital to increase his plant. This plant will be located in Bath, N. Y. Articles of incorporation will be filed shortly.

The Harquis Clay & Limestone Company, of New Castle, Pa., is reported to have absorbed the Pennsylvania Portland Cement Company, which is preparing to erect a $1,000,000 cement plant there in the spring.

Broker J. H. Kruse, of 314 First street, Hoboken, N. J., is understood to have induced a machine company to establish its plant there. Herman Delle, a property owner, may put up a building for the purpose.

It is stated at Grundy Center, Ia., that a company has been organized, consisting of Charles Smith, Charles and Amos Burd and G. W. Morrison, to manufacture a manure spreader, on which Charles Smith recently secured a patent.

It is stated that the Musser sawmill at Muscatine, Iowa, will be converted into a button factory with Eastern and Muscatine capital behind the enterprise. It will be equipped with all the latest and some newly patented machinery.

Richard Clough, E. W. Giddings, L. C. Perkins and W. S. Morris, well known citizens of Colorado Springs Colo., filed articles of copartnership with the county clerk under the name of the Clyde Lumber Company, and will erect a sawmill.

The F. N. Wedge Hoisting & Conveying Machine Company has been formed with a capital of $20,000, which will be increased later, and it is planned to erect a plant in Cleveland, Ohio, which will be the headquarters of the new concern.

The matter of securing the location of the Horrocks desk factory at Herkimer, N. Y., is before the Herkimer Business Men's Association, and it is said that a tentative agreement has been reached. Two hundred men would be employed.

It is stated at Eugene, Ore., that Chief Engineer Diers, of the Willamette Valley Electric Railway Company, is to put a force of men at work at Martin's Rapids, on the McKenzie River, where water-power will be electrically developed.

A real estate transaction in South Chicago has revealed the fact that an Eastern syndicate is seeking to control a large tract of land south of One Hundred and Sixth street, on the Calumet River, for the erection of a $5,000,000 steel plant.

At a meeting of Harrison, Ark., men to consider building a woolen mill, a committee was appointed to inquire about the cost and solicit subscriptions. It included John A. Bunch, W. Y. Meyer, W. H. Cecil, W. F. Gordon and F. R. Michel.

The Empire Foundry Company New Brunswick, N. J., which operates a plant for the manufacture of stove castings, has absorbed the Criterion Gas Company, of New York. Work has been started on the erection of a two-story addition to the local company's plant in Jersey avenue.

It is reported that the J. V. Newlin Manufacturing Company has completed the erection of its new foundry at Sebring, O., and expects to build a machine shop in the spring. The foundry is 60x80 feet, and the machine shop will be of similar size.

The Globe Rolling Mill Company, Cincinnati, O., has leased the Resor foundry property, at Front and Smith streets, for seven years, with a privilege of purchase. It is starting to remodel the buildings and will consolidate other plants there.

S. M. Jones Company, Toledo, O., on account of the great volume of gas engine business, will enlarge its plant. It is probable that a new gas engine for automobile use principally, invented by Edward Rathburn, will be manufactured by the company.

The Neely Manufacturing Company, of Yorkville, S. C., has been organized, with the election of Thomas P. Moore as president and treasurer, for the purpose of building a cotton yarn mill. He has been for years with the Alpine Cotton Mills of Morganton, N. C.

The Blair-Ruehl Glass Company has secured a site near Manchester, Va. Percy S. Bosher, of Richmond, is president, and George O. Ruehl, of Baltimore, Md., general manager. The company will manufacture druggists', perfumers' and jobbers' glassware.

A concern called the Publishers' Paper Company is, we understand, being organized, with Wm. H. Hall, of the Casein Company of America (which has an office at 5 Nassau street, New York city) as president, and in the spring may start work on a plant at Portsmouth, N. H.

Hugo Jacobson, of St. Etienne, France, director of the Compagnie Generale des Produits Metallique, manufacturer of iron and steel products, has been visiting places in the Middle West, etc., and is quoted as stating that the company proposes to build a plant in this country.

A sugar mill is being erected on the Santa Cruz Vista Alegre hacienda, in the State of Mexico, Mex., under the supervision of George S. Herbert, of Celaya, who is himself the owner of several sugar plantations, one of which is in the State of Michoacan, where he proposes to build a mill.

The California-Nevada Mining, Milling & Power Company has been organized under Arizona laws, with $5,000,000 capital stock, by Geo. S. Nixon, United States Senator-elect from Nevada, *et al*. It proposes to generate about 10,000 horse-power on creeks not far from the Goldfield district.

Negotiations have been in progress looking to the developing of the Bluetta Falls water-power, on the Pee Dee River, eight miles from Rockingham, N. C. Options have been taken by Hugh McRae & Co. It is proposed to distribute the power by electricity to points within twenty or thirty miles.

W. A. Elletson, proprietor of the Elletson Printorium, Parkersburg, W. Va., has formed a consolidation with Edgar Carver, in the printing business, and the concern will hereafter be known as the Elletson-Carver Company. It will be capitalized at $50,000 and new equipment is to be purchased.

The Davenport (Ia.) Locomotive Works has plans for extensive enlargements under consideration, at least, and according to a report has let the contract for a 60x150-foot boiler shop to be equipped with hydraulic and pneumatic machinery and electric cranes. This is not all of the improvements.

William Lacey, a Michigan City (Ind.) man, has patented a device for weighing which is attached to the scoop of ordinary scales. It is proposed to organize a stock company under the laws of New Jersey, and with a capital stock of $100,000. The factory will be located at South Bend, Ind.

The Canadian Corundum Wheel Company, Hamilton, Ont., is to make vitrified wheels. A new building for this purpose is being erected at the company's works. This is a new industry in Canada, these wheels hitherto having been imported. The value of such imports last year amounted to $25,000.

The Northern Shade Company, of Minnesota, has filed articles of incorporation. The plant will be built at St. Anthony Park and will manufacture window shades and blinds. It is capitalized at $100,000. Among the incorporators are Vernon C. Whitcomb, Clinton C. Richardson and Warren Bartholf, of Minneapolis.

Prof. George E. Hale, of the Yerkes Observatory, who is establishing an observatory on Mount Wilson, has addressed the Board of Trade of Pasadena, Cal., concerning the establishment there of a laboratory and machine shop to cost $5,000 and be equipped with $10,000 worth of machinery and apparatus.

It is understood that the Eggerdinger Tool Company's works, Vincennes, Ind., will be brought to Mannington, W. Va., and doubled in capacity. The line of work will embrace a variety of tools especially for working wood. Work on the buildings, the first of which will be about 50x100 feet, has probably begun.

S. D. Griffin, clerk of the Board of Trustees of the Sanitary District of Chicago, will receive bids February 15 for furnishing and installing alternating-current generators, to consist of four 4,000-kilowatt, 6,600-volt, three-phase 60-cycle machines, 164 revolutions per minute, and two 350-kilowatt, 250-volt, direct-current generators, 300 revolutions per minute.

Sir Alfred Harmsworth, Leicester Harmsworth, Harold Harmsworth and another, all of London England, have been incorporated at St. Johns, N. F., as the Anglo-Newfoundland Development Company, with a capital of $5,000,000, for the manufacture of pulp and paper in this island, having acquired large properties there. Operations will be begun early in the spring.

Col. T. G. Bush and associates, who are the recent purchasers of a controlling interest in the Alabama Consolidated Coal & Iron Company, have organized a company for the purpose of erecting a cast-iron soilpipe and fittings plant in Gadsden, Ala. Col. Bush is perhaps a Birmingham man, but Morris Bush, who is also prominently identified with the project, is of Gadsden.

Daniel F. Shordan, a Fort Wayne, Ind., agricultural implement man, has secured from inventor Keith, of Michigan, patents on a new plow point, and has interested with him John M. Landenberger and others. A company, which will be known as the Central Foundry & Plow Point Company, with headquarters in Fort Wayne, proposes to establish a plant to make the points and perhaps plows. It is not known whether the company will purchase a foundry outright or build a new foundry of its own. Mr. Landenberger will be president.

New Catalogs.

P. W. Post, Wausau, Wis. Metal sawing machines. Illustrated folder.

Speed Changing Pulley Company, Indianapolis, Ind. Circular and price list of style "D" countershaft.

Gisholt Machine Company, Madison, Wis., is sending out a folder referring to tools exhibited at St. Louis.

C. W. Spicer, Plainfield, N. J. Booklet describing the Spicer universal joint. Illustrated. 4½x6, pp. 11, paper.

Fort Wayne Electric Works, Fort Wayne, Ind. Bulletin No. 1060, describing portable wattmeter calibrators. Illustrated.

A. Nacke & Son, 236 South Ninth street, Philadelphia, Pa. Pamphlet, "Information for Inventors." Illustrated. 4x6, paper.

John Royle & Sons, Paterson, N. J., manufacturers of engravers' machinery, have issued a neat and serviceable pocket diary for 1905.

Wyman & Gordon, Cleveland, O.; Worcester, Mass. "A Short Story of Charles Babbage and His Calculating Machines"—Part 1. 4½x7, paper.

James L. Taylor, 30 Lawrence street, Newark, N. J. Catalog and price list No. 5 of the Taylor self-locking screw clamps. Illustrated. 3½x6, pp. 16, paper.

The Hydraulic Press Manufacturing Company, Mt. Gilead, Ohio. Folder describing hydraulic presses, for various services, made by this company. Illustrated.

Patterson Tool & Supply Company, Dayton, Ohio. Catalog of engine lathes, power hammers, power hack-saws, drilling machines, grinders, etc. Illustrated. 6x9, paper.

Pope Manufacturing Company, Hartford, Conn. Catalog illustrating the design and construction of Pope Hartford automobiles, model "B" improved. 6x9, pp 12, paper.

Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. Circular No. 1096, January, 1905. "Oil Switches and Oil Circuit-Breakers." Illustrated, 7x10, pp. 19.

Grant Gear Works, Inc., 6 Portland street, Boston, Mass. 1905 catalog containing stock gear list with prices and hints on gearing, together with tables and gear chart. 5½x8, paper.

Haberkorn Engine Company, Fort Wayne, Ind. Catalog describing various types and styles of engines made by this company, with half-tone illustrations and line drawings. 6x9, paper.

Springfield (Ohio) Machine Tool Co. 1905 catalog of engine, turret and brass lathes, shapers, power presses and other machine tools made by this company. Illustrated. 9x12, pp. 23, paper.

American Valve Company, Coxsackie, N. Y. 1905 illustrated catalog and price list of valves, including bronze gate, globe and angle valves and iron body bronze mounted gate valves. 4¾x7, pp. 32.

Hampden Corundum Wheel Company, Brightwood, Springfield, Mass. Catalog and

price list of emery and corundum wheels of different sizes and shapes, with table of speeds and other information. 5x7, pp. 47, paper.

Hall Manufacturing Company, 62 Cliff street, New York. Catalog No. 9 describing oil cups, oil gages, oil syringes, waste oil purifier and refilter and other products of this company. Illustrated. 4x6½, pp. 73, paper.

The Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. Circular No. 1068 of type "S" dynamos and motors, direct current, with illustrations of a number of applications to machine tool drive. 7x10, pp. 15.

Dodge Manufacturing Company, Mishawaka, Ind. Catalog No. 61, "Dodge Flywheels and Hardwood Lagging System," wherein are shown some very large flywheels, balance wheels, transmitters, etc., built by this company. 9x12, pp. 14, paper.

Arguto Oilless Bearing Company, Wayne Junction, Philadelphia, Pa. Catalog containing half-tone illustrations showing application of the bearings made by this company for various purposes, price list and testimonials. 4½x7, pp. 40, paper.

Standard Gauge Steel Company, Beaver Falls, Pa. Illustrated catalog and price list of machine keys, machine rack, elevator guides and other finished steel specialties, including a number of pages of tables and useful information. 4x6½, pp. 96, paper.

Page-Storms Drop Forge Company, Springfield, Mass. Catalog of drop-forged specialties, including engineers' and machinists' wrenches, tool-posts, golf irons, commutator segments, automobile and gas engine forgings. Half-tone illustrations. 6x9, pp. 46, paper.

The Williams Electric Machine Company, Akron, Ohio. Illustrated catalog of electric clutches and safety devices, clutch pulleys, elevator and hoisting machinery. There are some 30 pages of tables, information and data on transmission and general mechanics. 6x9, pp. 70, paper.

Hart Corundum Wheel Company, Hamilton, Canada. Illustrated catalog of corundum and emery grinding wheels, paper polishing wheels, "Cyclone" grinding machinery, planer knife grinders, saw filers and gummers, with results of comparative emery wheel tests and other information of use to those interested in abrasives. 6x9, pp. 78, paper.

American Emery Wheel Works, Providence, R. I. Catalog illustrating and describing emery and corundum wheels of all sizes and for all purposes made by this company. Attention is called to the large list of special shapes included. There are shown, also, a number of standard and special emery and corundum sticks and stones. 6x9, pp. 75, paper.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis. We have received from this company a number of descriptive bulletins of C. & H. "Compound" starting and regulating rheostats with underload and overload release, reversible machine tool controllers, enclosed reversible and non-reversible compound controllers, also an index of the various bulletins published by this company.

The Citizens' Alliance, of Joliet, Ill., has sent out a publication the purpose of which is to direct attention to the advantages of Joliet for manufacturing and residential purposes. Many interesting facts regarding features and facilities of the city are enumerated, and views are shown of the manufacturing districts, parks, churches and schools. Joliet has abundant water-power, and it is stated that within a distance of four miles the city will soon have developed and ready for use 65,000 horse-power from the flow of water furnished by the ship canal from Chicago.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Addressing machines for office use. Joline & Co., 123 Liberty St., New York.

Light mach'y to order; model work; rubber molds. J. W. Weir, Bridgeport, Conn.

Wanted—A second-hand oval chuck; any size will do. Address Box 241, AM. MACH.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

A set of steel figures, size 3-32 or ⅛ in.; $1.25, post paid. J. L. Lucas, Bridgeport, Ct.

100 copies "Dies and Diemaking" at 50 cts. each; slightly damaged; sent post paid. J. L. Lucas, Bridgeport, Conn.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Auto. machinery of all kinds designed and built; hardened and ground work, flat or circular. Wiebking, Hardinge & Co., Chicago.

The Canada Machinery Company, Limited, Sarnia, Canada, have the facilities and are open to manufacture, for patentees and others, machines and machinery for the Canadian market.

Wanted—To furnish competent men for positions as managers and heads of departments in the metal-working or machine business and the past experience of each, for which there is no charge; also want competent men to register for such positions. Address James Brady, 168 Lefferts Place, Brooklyn, N. Y.

Wanted—New or second-hand, up-to-date tools for manufacturing iron valves and fittings, screwed and flanged; 1 10 in. or 12 in. spindle multiple drill, improved pattern; 1 small engine lathe, about 16 in., with taper attachment; 1 universal grinder for tools, Cincinnati pattern; brass monitors; 1 machine for facing three sides of flanged valve at one process; 1 three-way tapping machine for tapping valves and fittings, 3 in. size and larger; 1 or 2 smaller size; the above tapping machines—state number of fittings tapped at one time; 1 nipple machine; 1 large, heavy turret lathe for facing 4 in. to 6 in. valves. Want only modern tools, in good condition. Send description, photographs or catalogs, with lowest cash prices. Address P. O. Drawer B, St. John, N. B., Canada.

Business Opportunities.

Wanted—First-class foundryman with $1,000 or more to invest in manufacturing company in lively Western town. Box 219, AMERICAN MACHINIST.

An advantageous proposition is open to a technical man with from $5,000 to $10,000 capital, to acquire interest in profitable machine business and patents left in an estate; good designer and hustling superintendent wanted. "Partnership," care AMER. MACH.

Manager of a prosperous manufacturing company desires to retire; a competent mechanical engineer can secure position by purchasing an interest of $20,000; salary and dividends exceed $5,000; the right man can double this in a few years. Address Box 177, AMERICAN MACHINIST.

For Sale.

For Sale—Long-established machine shop in thriving city; cause of sale, death in firm. W. D. Judson, New Haven, Conn.

For Sale—In New York city, an established pattern shop with first-class equipment. Address "Patterns," care AMER. MACHINIST.

For Sale—Hand-power planer, 10x10x36 in.; good as new; well made; powerful; price $75; other tools for sale. C. S. Michener, 234 E. Main st., Kalamazoo, Mich.

For Sale—One set standard internal cylindrical gauges or plugs, from 1-16 in. to 2 in., varying by sixteenths; gauges are new; never been used; will sell very cheap. Address John Imschweiler, 5 Ogden Court, Rochester, N. Y.

I can sell your machine shop (or other business), with or without real estate, no matter where it is or what it is worth. Send description, state price and learn how. W. M. Ostrander 111 North American Bldg., Philadelphia.

For Sale—United States patent No. 719,854, 1903, for best water gage in the world; now giving splendid results on English market; see description on page 788, December issue of POWER. Apply James Robinson, G. P. O. Leeds, England.

For Sale—A controlling interest in a small manufacturing and jobbing machine shop in growing city in southern Michigan; well-established business; a splendid chance for a young machinist ambitious to have a shop and business of his own. Address A. B. C., care AMERICAN MACHINIST.

For Sale—A modern machine shop, complete with water power, suitable for manufacturing and jobbing purposes; is now running at Londonderry, Vt.; cause of selling, death of proprietor. Address Mrs. H. A. Hayward, Londonderry, Vt.; or Kansas City Machine Works, Kansas City, Mo.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona-fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Mechanical draftsman, 26, a technical graduate with 4 years' practical experience, best references, wishes to change. Box 180, A. M.

ENGLAND.

By an up-to-date engineer, responsible position in building steam turbines; long experience; best of references; free after February 1; West preferred. Box 173, AMER. MACH.

ILLINOIS.

Broadly qualified machine works general superintendent, desiring new location, invites confidential inquiries; state particulars. "Conservant," care AMERICAN MACHINIST.

Mechanical engineer, graduated, with shop and office experience, capable handling men and doing original work, wants to change position; A1 references; location no matter. Box 234, AMERICAN MACHINIST.

Machinery salesman, practical machinist, now Western manager for Eastern company, desires to change; prefers Eastern territory; invites correspondence with particulars. Address "Excel," care AMERICAN MACHINIST.

MAINE.

A party of patternmakers, including foreman, wish to correspond with some new or established firm in need of first-class, sober and industrious patternmakers; experienced in various classes of work and furnishing best of references. Address D., care AMER. MACH.

MASSACHUSETTS.

Mechanical draftsman wishes position. Address Box 235, AMERICAN MACHINIST.

Foreman blacksmith of experience would like situation in the West; A1 reputation. Box 215, AMERICAN MACHINIST.

Mechanical draftsman and practical machinist, designer of tools, electrical, special and automatic machinery, desires responsible position. Box 167, AMERICAN MACHINIST.

MICHIGAN.

Wanted—Position as superintendent or general foreman; first-class experience in both positions and capable. Box 220, AM. MACH.

NEW JERSEY.

Designer wants position; college graduate; 8 years' experience electrical and hoisting machinery. Box 200, AMERICAN MACHINIST.

By A1 draftsman; long and varied experience enables him to tackle any design to satisfaction. Box 216, AMERICAN MACHINIST.

Position as superintendent or general foreman of machine shop; all-round, broad-gauge man; first-class reference. Box 236, AM. M.

Mechanical draftsman wants position with a first-class firm; age 26; experience, 8 years on engines and mill machinery. Box 218, AMERICAN MACHINIST.

An up-to-date superintendent on interchangeable automatic machinery and tool work would like such a position with a good company in N. Y. or Conn. Box 228, AM. M.

Mechanical engineer, age 34, with inventive ability and experience in designing and building special machinery, desires change; would like position with manufacturing establishment. Box 223, AMERICAN MACHINIST.

NEW YORK.

Gasoline automobile designer, with best actual results, wants responsible position. Box 231, AMERICAN MACHINIST.